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A Further Stratigraphic Study in the Mount Diablo Range of California

BY

FRANK M. ANDERSON

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INTRODUCTION

When the earlier paper on this subject was published, under similar title, in 1905,[1] it was intended that it should be the first of a series of contributions to be offered at intervals as time and opportunity were afforded for the further study of the region. During its preparation it was not unforeseen that some of the details, or some of the applications of general conclusions, would subsequently require alteration or amendment, as exploration in the field should be extended farther and a more complete knowledge of the details should be acquired. With this in view it was nevertheless believed that such a contribution would be well worth while, even though corrections might be found necessary as the study progressed, since it would at least serve to stimulate investigation and thus tend to develop our knowledge of the subject. And this result has undoubtedly been attained.

Since the publication of the former paper, the attention of the U. S. Geological Survey has been directed to this field; and a systematic study of its stratigraphic and economic features has been begun, which will undoubtedly add much to our present knowledge.

During the two years and more since the publication of the earlier paper, exploration has been extended along both sides of the range for many miles beyond the portions that had then been covered, affording opportunity for more detailed work and for a better acquaintance with the stratigraphy and with the conditions under which deposition took place than was then possible.

Prior to, and after the publication of the former paper, large collections of fossils, chiefly marine invertebrates, had been made from all of the formations represented. As these had been stored in the Academy of Sciences, they were lost when it was burned in the great fire of San Francisco. In-

[1] Proc. Calif. Acad. Sci. 3d ser. Geol. v. 2, no. 2, pp. 156-248.

deed, at the time of the fire the present paper was in process of preparation and the manuscript was partly written; but on account of the destruction of the collections, its publication has not only been delayed, but in the form and matter of its contents it has been considerably altered and reduced.

The general statements made in the earlier paper concerning the stratigraphic sequence in the Mount Diablo range, have proved to be fairly correct, and the same may be said of the formal statement of conclusions. It is only in their application within a certain definite portion of the field (and this within the area covered by the map) that any amendment is required. However, under a combination of circumstances, such error was unavoidable: In the first place, the field had been approached from the south, which was a direction of several disadvantages; in the second place, little was known from the literature concerning the general stratigraphy of the Eocene, and supposed Oligocene of the West-coast, and less concerning the geologic range of certain species of invertebrates, such as *Pecten peckhami,* and certain species of *Tellina* and *Leda,* and of several forms in the later Neocene.

Since the former publication, however, some important additions have been made to the literature of the West-coast Tertiary, chiefly by Dr. Ralph Arnold[1] and by Geo. H. Eldridge and Arnold;[2] and the paleontology of the Tertiary formations of the West has been somewhat enlarged.

It is due also to remember certain observations made by Mr. J. S. Diller,[3] presumably upon the authority of Dr. Dall, regarding the occurrence of *Pecten peckhami* in the supposed Oligocene deposits of northwestern Oregon. While it may remain to be proved that the entire series described by Mr. Diller is properly referable to the Oligocene, it is clear that below a great thickness of sandy strata which are probably lower Miocene, there is a still greater series of ashy clay shales

[1] Tert. and Quat. Pectens of Calif. U. S. Geol. Surv. Prof. paper 47, 1906.

[2] See discussion of the oil districts of southern California in Bulls. 309 and 321, U. S. Geol. Surv.

[3] U. S. Geol. Surv. 17th Ann. Rept. pt. 1, pp. 464-469.

and sandstones with a very different fauna. Toward the top of this lower series the fauna includes:

Dolium petrosum CONRAD	*Scaphander*
Nucula truncata GABB	*Cylichna*
Yoldia impressa CONRAD	*Leda*
Pseudomusium peckhami GABB	*Tellina*
Dentalium	

And still lower in the conformable series was collected a fauna that was referred without a doubt to the Eocene, among which were the following:

Heteroterma trochoidea GABB (?)	*Pyrula tricostata* LAM.
Rimella canalifera GABB	*Aturia angustata* CONRAD
Urosyca candata GABB	

Mr. Diller adds: "Notwithstanding the presence of *Aturia,* which is a characteristic Oligocene form, Dr. Dall refers these fossils to the Eocene."

Writing later of the Oligocene in the United States, Dr. Dall[1] says: "In the southeastern United States there is no marked stratigraphic break between the Eocene and the Oligocene. Many of the fossils persist into the upper beds, but the fauna as a whole undergoes a well-marked alteration, showing that physical changes of some sort, such as would profoundly affect the fauna, must have taken place. The change by which the Oligocene was brought to a close and the typical Miocene inaugurated, caused, as already described, the most remarkable faunal break in the geological history of the United States after the Cretaceous."

The stratigraphic relations of undoubted Oligocene deposits in California have not been so clearly stated, though there are supposed Oligocene deposits on the southern coast that have been similarly described.

Dr. Ralph Arnold[2] has described Oligocene deposits from the Santa Cruz mountains lying below the lower Miocene with a fauna which he considers intermediate between typical Tejon and lower Miocene. This fauna includes *Pecten peckhami* and other forms not unknown in the Miocene of California.

[1] U. S. Geol. Surv. 18th Ann. Rept. pt. 2, p. 331.
[2] U. S. Geol. Surv. Prof. paper 47, pp. 16-17.

Geo. H. Eldridge and Arnold[1] have also described beds of transitional character, presumably Oligocene, as occurring in the Coast ranges of Ventura county, California. Eldridge and Watts[2] had considered this series, known as the Sespe formation, to be of Eocene age; but as Arnold found Miocene fossils in its fauna, it has been provisionally referred to the Oligocene.

It appears, therefore, that below the Miocene, and occupying an intermediate position between it and the Eocene, there occur in Washington, Oregon, and California, marine beds that have been provisionally referred to the Oligocene, and that appear to be conformably related to the Eocene deposits, but from which the Miocene is more or less separated by either a stratigraphic or a faunal break. In the following pages illustrations will be found in which similar relations appear, but in which the strata involved have not yet been proved to be of the Oligocene age.

It is the purpose of this second paper to present results that have been attained since the publication of the first, to amend it where necessary, and to supplement it by the addition of such new facts as have been gathered in the more extended study of the field. Furthermore, as the former paper has become all but inaccessible through the total destruction of the reserve stock of the publications of the California Academy of Sciences, it is thought worth while to embody its results, in an abbreviated and improved form, in a second publication.

It is not intended that this paper shall be complete either in its scope or in its treatment of the subject, but that it shall, at least, be suggestive of some of the many interesting features of the field, and of the various phases of geological study that find here abundant and excellent illustration.

One of the important factors to be considered and worked out in a stratigraphic study of any region is that of the conditions of deposition—that is, the physical geography of the time and the various influences that may have affected the

[1] U. S. Geol. Surv. Bull. 309, pp. 7-12.
[2] Calif. State Min. Bur. Bull. 11, pp. 25-26.

character and distribution of the sediments of which the strata are composed. In the Tertiary deposits of the Mount Diablo range, along its entire extent of nearly 300 miles, there is a great variation in the character and composition of the constituent rocks, presenting every variety from coarse detrital conglomerates to two or three forms of fine organic shales and limestones, and alternations of these that are possible only under conditions far from simple.

Conditions of Deposition during the Tertiary

During the Tertiary periods, if not during the Cretaceous, the physical geography of western California differed widely from that of the present time. In the positions of many present centers of stratification, constituting the main summits of the Coast ranges which now rise with more or less regularity and continuity, there existed during and throughout the Tertiary, at least, only chains of continental islands grouped in similar alignment. These island masses were not unlike some that now exist about the borders of the Pacific ocean and on the coasts of Alaska and even of California. Among them were enclosed seas, or basins, with interconnecting channels through which the tides and ocean currents ran at will, thus forming an unusual variety of conditions which directly influenced the character and variety of the faunas of the time.

Among such basins were the Great valley, the Salinas, the Santa Maria-Carisa, and the San Fernando valleys. But for the present, without attempting to make a complete statement of either the Coast range waterways or island groups of the Tertiary, it is sufficient to note only the fact that along the course of the Mount Diablo range six or more centers, or stratigraphic cores, have been recognized and to some extent correctly described by Whitney as the natural divisions of the range. These centers were to some extent outlined in the former paper; they deserve far more attention than can be given here. But while Whitney correctly observed and noted these various divisions of the range, its double character and

other complex features have hitherto escaped attention. However, these points can not be taken up in the present paper.

Among the divisions enumerated by Whitney are the Panoche, the San Carlos, and the Estrella, which, he says, are individualized by certain low passes extending across the range. Considering these divisions as separate islands or groups, it would ultimately be necessary to subdivide some of them at least into two, or perhaps three sections for special epochs of the Tertiary, with waterways extending from the basin of the Great valley to that of the Salinas. One of these open channels lay along the course of the west branch of the Jacalitos and the upper Warthan creeks, and one along the Los Gatos creek and the San Benito river, thus dividing the San Carlos division into three sections or subdivisions for at least a part of the Tertiary. In a complete or detailed study of the range, other channels and the islands separated by them at one time or another would require notice, but those mentioned are perhaps sufficient to illustrate the nature of the problem.

In all probability, as time went on during the successive periods or epochs, certain geographical changes occurred which resulted in either increasing or decreasing the width and number of these transverse channels; and these results could have been accomplished by simple changes in elevation. It appears that during the Miocene period only the Warthan channel was open, while during the Pliocene both the Warthan and the Los Gatos channels were in existence, as is shown by the distribution of the Miocene and Pliocene sediments along them.

The islands and channels that existed during the Eocene can not be so easily discerned, but undoubtedly there were many.

Eocene sediments run well into the range, if not across it, on the borders of the Livermore and Panoche valleys; and the same is probably true in the neighborhood of the Antelope and the Cholame valleys, as well as farther south.

Probably this statement of the insular condition in Tertiary times is sufficient to illustrate some of the factors that affected

the character, quantity, and distribution of the various strata concerned in this discussion. It will readily be conceded that the sorting and transporting influence of ocean currents through channels and waterways can not be small, and that it is entirely adequate to explain many of the seeming irregularities, both lithological and faunal, that may appear later in the course of these studies. There are in some quarters rapid transitions in both the nature of the sediments and the character of the fauna as one follows the strata along their strike. Some important beds are known to entirely disappear or to change their character or appearance to such an extent that they can be recognized only by their stratigraphic position with respect to others that are better known. The later Miocene particularly appears to have been an epoch of rapid changes in these respects, but of changes that are explainable by sufficient attention to the details of physical geography.

The Cretaceous and Earlier Series

It is not designed to give here any special account of the Cretaceous and earlier rocks of the range, although both are abundant about each of its older centers, as was illustrated in the former paper. The occurrences of Cretaceous and "metamorphic" rocks have been noted by Whitney[1] at Mount Diablo, Corral Hollow, and Panoche Pass, and have been followed by him as far to the south as the Panoche valley. Becker[2] and White have published lists of Chico species occurring at New Idria, and similar beds have been identified upon the tributaries of the Cantua and Salt creeks. Miss H. C. Lillis has collected from these beds the following species, which were left at the University of California:

Baculites chicoënsis	*Baculites* sp.
Arca breweriana	*Chione* sp.
Dentalium stramineum	*Perissolax* sp.
Cinulia obliqua	*Natica* sp.
Gyrodes conradiana	*Margarita* sp.

[1] Geol. Surv. Calif. Geol. v. 1, pp. 45, 55, etc.
[2] U. S. Geol. Surv. Monog. no. 13, pp. 291-309.

From Salt creek these Cretaceous rocks have been followed continuously to the Los Gatos, Warthan, Jacalitos, and Avenal creeks, and indeed to the Devil's Den, on the north side of the Antelope valley. It is quite probable that the tawny yellow sandstones occurring south of the Antelope valley are of Cretaceous age, but as yet no proof of it is at hand.

From the published lists of fossils occurring in the range it would appear that the Chico portion of the Cretaceous has been more often identified, though species of *Aucella* have proved the presence of the Knoxville at Mount Diablo (and Becker was convinced that some of the rocks at New Idria belong to the "Knoxville series"), while from the black shales on the Jacalitos creek species of *Hoplites* have been found, and at the Devil's Den both *Hoplites* and *Belemnites* were collected in similar dark shales.

It thus appears that both Knoxville and Chico strata enter into the composition of the range and are far more abundant upon the eastern flank than upon the western. The Cretaceous rocks always stand at a high angle, dipping away from the older formations and toward the valley at points of the compass varying according to their position. It is designed however that the structure of these and the younger series of formations shall be reserved to be dealt with later.

The so-called "metamorphic" rocks of the Mount Diablo range, occurring at intervals and in large areas, have generally included serpentines, trachytes, porphyries, and jaspers. The stratified portions are all representatives of the Franciscan series, while the eruptives include many of the classes usually found associated with them in the Coast ranges, among which are the products of local metamorphism of the most pronounced kinds.

The Eocene Rocks

Distribution.—The Eocene rocks of the northern portion of the range have already had considerable mention by various writers, including Stanton,[1] Merriam,[2] Weaver,[3] and others.

[1] U. S. Geol. Surv. 17th Ann. Rept. 1896, pp. 1009-1060.
[2] Journ. Geol. v. 5, no. 8, pp, 767-775.
[3] Bull. Dept. Geol. Univ. Calif. v. 4, no. 5, pp. 101-123.

From the Straits of Carquinez they extend easterly, forming a well defined belt along the northern border of Mount Diablo, which can be followed as far eastward as Byron or Brentwood. Farther south the more important areas that have been noted are at Corral Hollow,[1] New Idria,[2] Coalinga,[3] and southward.

While Eocene rocks have not been followed continuously along the range, it is perhaps due to lack of exploration rather than to their absence. From New Idria the Eocene can be followed westerly for an indefinite distance, while to the east and south it has been followed continuously to Coalinga. The following list of fossils was obtained by the writer at Corral Hollow, from a stratum a few hundred feet above the Eureka vein of the Tesla coal mine:

Neverita secta Gabb
Tritonium sp. undet.
Turritella uvasana Gabb
Dentalium cooperi Gabb
Amauropsis alveata Gabb
Actæon sp. undescr.
Tellina longa Gabb
Leda gabbi Conrad
Solen stantoni Weaver
Lucina (?) cretacea Gabb
Mactra sp. undescr.
Meretrix horni Gabb

On the south side of the canyon other Eocene species were obtained, and it is evident that most of the coal veins of this vicinity are in rocks of Eocene age.

H. W. Turner[4] recognized the white sandstones occurring at New Idria as of Eocene age and reports the following species from De Los Reyes canyon:

Ostrea idriaënsis Gabb
Neverita globosa Gabb
Rimella canalifera Gabb
Cylichna costata Gabb
Morio (Sconsia) tuberculatus Gabb
Amauropsis alveata Gabb
Meretrix uvasana Conrad
Turritella, fragment

Within 50 feet of the coal vein occurring near by he obtained:

Solen (Hypogella) diegoënsis Gabb
Neverita sp. undet.
Small lamellibranchs

[1] Geol. Surv. Calif. Geol. v. 1, pp. 34 *et seq.*
[2] U. S. Geol. Surv. Monog. no. 13, pp. 291-309.
[3] Proc. Calif. Acad. Sci. 3d ser. Geol. v. 2, no. 2, pp. 162 *et seq.*
[4] Am. Geol. v. 14, pp. 92-96.

From other localities in the neighborhood, he adds:

Cardium cooperi Gabb	*Lucina (?) cretacea* Gabb
Pecten interradiatus Gabb	*Mactra* sp. undet.
Modiola ornata Gabb	

To the south and east of Coalinga a narrow belt of Eocene beds can be followed for a distance of more than 15 miles, extending from certain tributaries of the Jacalitos creek eastward to the vicinity of Dudley on the northern border of the Sunflower valley. These beds appear again near the Point of Rocks on the northern border of the Antelope valley, from which locality several Tejon forms have been obtained and listed. To the south of the Antelope valley the Eocene beds can be followed without difficulty as far as Temblor, if not farther toward the southern extremity of the range. They appear again crossing the canyon of the San Emidio and can be followed from there eastward to the Tejon ranch.

Among other characteristics of the Eocene rocks, at least on the eastern side of the range, is the presence of beds of lignitic coal, or in some cases of carbonaceous clays, particularly in places where the Eocene section is greatly reduced. Almost all the coal veins reported along the valley side of the range, and some on the opposite side, are in Eocene strata.

Like the Cretaceous, the Eocene rocks are in evidence to a far greater extent upon the eastern than upon the western slope of the range, though they are known upon both.

North of the Straits of Carquinez, the Eocene has been noted as far as Upper Lake, Lake county, though its continuity is not known to be complete.

Stratigraphy of the Eocene.—In the vicinity of Martinez, the Eocene strata have been divided into two groups, mainly upon the basis of their faunas, and have been classed accordingly as Martinez and Tejon. The older, or Martinez, portion has been made the subject of a special study by Dr. J. C. Merriam[1] and by Chas. E. Weaver,[2] while the Eocene series, as a whole, has been clearly separated from the Chico by Dr. T. W. Stanton.[3]

[1] Journ. Geol. v. 5, no. 8, pp. 767-774.
[2] Bull. Dept. Geol. Univ. Calif. v. 4, no. 5, pp. 101-123.
[3] U. S. Geol. Surv. 17th Ann. Rept. pt. 1, pp. 1011-1049.

In the northern part of the range the rocks are generally covered by soil to an extent that renders the stratification more or less obscure; so that little attempt has been made toward a detailed statement of their lithological characters.

Mr. Weaver states that the Martinez beds, for the most part, consist of thick bedded sandstones containing large quantities of glauconite, and that alternating with these are considerable beds of shale.

In the vicinity of Corral Hollow both sandstones and shales enter into the composition of the Eocene; but no systematic statement of the strata has yet been made, except such as is given by Whitney, who did not, however, differentiate the Chico from the Tejon.

The belt of Eocene rocks lying between the Panoche Pass and Coalinga probably offers the best exposures and affords the best opportunity for both general and detailed lithologic study, and possibly an equally good opportunity for a formal classification. Along the Cantua creek, and both to the east and the west, a thick series of conformable strata can be followed easily for many miles. The aggregate thickness of the series is not less than 6000 feet, and is probably more. This series is readily divisible into four horizons, as follows:

Upper shales, organic	1800	feet
Upper sandstones, fossiliferous	2500	"
Lower shales, brown clays, etc.	1000	"
Lower sandstones, concretionary	1000	"

Toward the southeast the series becomes perceptibly thinner, until in the vicinity of Coalinga it narrows to a point and entirely disappears below the succeeding series of Miocene.

The Lower Sandstones.—The lower sandstones of the Eocene series have not been thoroughly studied, and fossils have not yet been found in them within this area; therefore their classification as Eocene is based upon other evidence than fauna. They consist of soft and crumbling sandstone with a few harder layers, some of which are calcareous and are in some places more or less concretionary. A good example of these lower concretionary sands is to be seen in the rocky hill immediately northwest of "Oil City", Coalinga field. These

lower sands can be followed from this point both north and south for several miles. They rest upon dark clay shales of Chico age, with which they show every evidence of unconformity. In the former paper, these beds were called, provisionally, the "Avenal Sandstones", although they had not been followed continuously from the wells at Avenal, from which their name was taken.

The Lower Shales.—The next member of the series is one of rather unique character among the formations of the Mount Diablo range, chiefly on account of its purple-brown color and topographic effect. The shales, though sometimes calcareous or sandy and frequently filled with organic remains, are, on the whole, predominatingly clays. The calcareous portions are usually white lenticular masses only a few feet in extent, containing a variety of Foraminifera. Besides the white calcareous lenses, there are usually many scattered nodules of barite, fragments of selenite, and often some layers of sandstone. In the western part of the Coalinga field a sandy layer was found to contain many characteristic Eocene forms and some that are peculiar to the Martinez division. Among the many remains of Foraminifera found in these shales, there are numerous tests of numuloid forms occurring either in the sandy layers or in the calcareous concretions. Some of the sandy layers also contain scattered granules resembling glauconite.

On one of the tributaries of Salt creek some of the sandy beds contain:

Turritella pachecoënsis STANTON	*Leda gabbi* CONRAD
	Fusus (cf. F. æquilateralis WEAVER)
Cardium cooperi GABB	*Cylichna costata* GABB, etc.

Though none of these species may be exclusively of Martinez age, yet all of them occur in that horizon, and their presence does not therefore conflict with such an assignment of the beds.

The topographic aspect of these shales is striking and renders them easy to follow along the flanks of the range. They are easily reduced by erosion and therefore occupy a succession of depressions within which the transverse drainage of the range converges into its larger streams. The scanty soil

resulting from their decomposition is usually adobe-like, and is favorable for the growth of stunted oaks and junipers, but for no other vegetation,—not even grass.

In the midst of a zone of hills which are destitute of trees, this belt of brown shales sprinkled with trees is not hard to follow. The shales are usually clay-like and brown on the surface, though in good exposures they show a variety of colors, some of them being either red, white, or greenish. It was this member that was called, for convenience, in the former paper, the "Kreyenhagen shales". In some places the beds become sandy toward the bottom, but this is not a constant feature throughout their extent along the range.

The Upper Sands.—The thickest member of the Eocene, at least where it is best exposed, along the Cantua creek in the vicinity of the Lillis ranch, is that which was formerly described as the "Domijean sands". Its thickness was roughly estimated as 2500 feet, though it may be more. As far as observed, there is considerable uniformity in composition, though there are some harder layers of fossil-bearing rock at intervals. In general these sands are yellow in color, soft and crumbling, with a disposition to weather into steep scarps imperfectly exposing the edges of the strata, which are often concealed by loose and sliding soil.

Except in the harder fossiliferous beds and in some concretionary layers, the sands are but little consolidated. Their greatest development is to be seen along the Cantua and Salt creeks and southward in the vicinity of the Domengine ranch, whence the name. The thickness of these sands is variable, but it increases somewhat regularly toward the north. In the vicinity of "Oil City", north of Coalinga, the thickness has been given as not over 350 feet, and a little north of the Domengine ranch as 1200 feet, while along the Cantua, it is not less than 2500 feet. Farther west it appears to again diminish though it extends at least as far as New Idria.

The fossils so far collected in this horizon are typically Tejon, though some of the species are found in the Martinez. In the vicinity of "Oil City", a hard layer at the base of the yellow sands yielded:

Turritella uvasana GABB	*Trochosmilia* sp.
Dentalium cooperi GABB	Foraminifera, many sp.
Cardium cooperi GABB	Crustacea sp.
Leda gabbi CONRAD	

Higher in the same beds and a little farther south, W. L. Watts[1] has collected:

Discohelix leana GABB	*Ficopsis cooperi* GABB
Turritella saffordi GABB	*Tritonium californicum* GABB
Turritella uvasana GABB	*Pectunculus sagitatus* GABB

A few miles north of this locality and near the Domengine ranch a hard sandy layer has yielded:

Meretrix horni GABB	*Turritella uvasana* GABB
Cardita veneriformis GABB	*Amauropsis alveata* GABB
Cardium cooperi GABB	Foraminifera (numuloid forms)
Pectunculus sagitatus GABB	Crustacea, etc.
Tellina horni GABB	

Along the Cantua this member of the series becomes more shaly toward the top, and the transition toward the succeeding member is not sharp but gradual. Farther south thin hard beds of sandstone mark the basal portion of the overlying shales, but they diminish in frequency higher up.

Crystals and veinlets of selenite are abundant in many parts of this member.

The Upper Shales.—The uppermost member of the conformable series that is here referred to the Eocene is one consisting almost entirely of shales, but containing some thin sandy beds near the bottom. On the Cantua creek east of the Lillis ranch house these shales are well exposed on the slopes and in the ravines on the north side of the stream. There is a total thickness of nearly 1800 feet, including some of the thin sandy beds near the top of the preceding member. They are divisible locally upon the basis of color and lithology into:

White chalky shales	800 feet
Brown clays, etc.	1000 "

Their unconformity with the succeeding beds is apparent, both from the abrupt change from fine organic shales to coarse grained sands or even pebbly gravels, and from the fact that

[1] Bull. no. 3, Calif. State Min. Bur. pp. 62 *et seq.*

in some places an angular difference in strike and dip is plainly to be seen. Furthermore, as the formations are followed southward, the series with which these shales are identified finally disappears beneath the later series.

The upper shales do not maintain the thickness stated above as they are followed southward. In the vicinity of the Domengine ranch, they are reduced to about 1000 feet, while at "Oil City" the thickness is not above 600 feet, and that of the entire Eocene series is only about 2500 feet. Farther south and west they entirely disappear in the western part of the Coalinga district.

The fauna of these shales consists of many forms of Foraminifera and marine diatoms, but with a scanty number of mollusks.

On the Cantua the upper white shales contain *Pecten peckhami* and many Foraminifera and diatoms. Near "Oil City" *Pecten peckhami* and other forms have been found by the writer and by W. L. Watts. Intermediate between these two localities, on Sec. 19, T. 18 S., R. 15 E., these white shales have furnished:

Pecten peckhami Gabb	*Tellina congesta (?)* Conrad
Leda oregona (?) Shum.	*Callista* sp.

It was these upper brown and white shales which, on the basis of both their lithology and their molluscan fauna, were regarded as Miocene, and therefore as "Monterey shales", in the former paper. Had the succeeding Lower Miocene series been as fossiliferous, however, as new localities have since shown it to be, or had it been followed into the localities where the great unconformity is more evident, it would have been less easy to confuse these earlier shales with their counterparts in the Miocene.

As to the definite assignment of these shales to either the Eocene or the Oligocene in the time scale of California geology, that must be reserved for further study and for some future time. Stratigraphically and structurally they are certainly connected closely with the Tejon series, while faunally they are allied more closely to the Miocene.

In its structural features the Eocene is simple. It forms a monocline that dips away from the older rocks toward the Great valley with only such flexures in strike and dip as are consistent with the insular conditions of the period. The beds lie along the eastern and northern slopes of the range in such a manner as to be in general concentric with the Cretaceous, presenting in some places the appearance of conformity, but on the whole showing the strongest evidences of unconformity. This unconformity is evident, as the formations are followed along the range, not only in the physical character of the various beds and in their fauna, but also in the distribution of the Eocene and the Cretaceous and in their lack of conformity in detail in many places.

On the western slope of the range, the structure of both the Eocene and the Cretaceous is less simple, and both formations are also less in evidence. The large amount of faulting which has taken place has complicated and obscured the geology, and no clear statement can be made without much detailed work.

THE MIOCENE SERIES

Regarding the occurrence, stratigraphy, and distribution of the Miocene in the Mount Diablo range, a fairly good statement was given in the former paper, except as to a part of the territory north of Coalinga. Miocene rocks are co-extensive with the range and can be followed almost continuously throughout its entire length, particularly along its eastern flanks.

In the earlier paper the stratigraphic divisions of the range were considered to be:

(c) Coalinga beds
(b) Monterey shales
(a) Temblor beds

These do not form an entirely conformable series, though in some places it is difficult, or even impossible, to draw the line sharply between the several members. The greatest degree

of conformity exists between the two lower members, and less between the others, as will be shown farther on.

The Temblor Beds.—Probably the most persistent member, after proper discriminations are made, is the lower, which is also the one best characterized by fossils, and is therefore the most easily recognized faunally. Its occurrence at the type locality has been already sufficiently described. It has also been noted at intervals along the eastern base of the range as far north as Coalinga. Northward of Coalinga the Temblor beds follow the range for an unknown distance, but certainly to the Cantua creek and to New Idria. They maintain a fairly uniform thickness and constant sequence of strata, though not always a constant fauna. Just north of the Cantua on the Lillis ranch, the following representative section was noted:

Neocene Strata			2000 feet
Temblor Beds			
(g)	Thin calcareous beds with *Turritella ocoyana*	30 feet	
(f)	Clay shales with Foraminifera	150 "	
(e)	Loose gray sands	60 "	
(d)	Thin calcareous sand with *Turritella ocoyana*	8 "	
(c)	Loose friable sands	80 "	
(b)	Yellow sands with *Turritella ocoyana*	8 "	
(a)	Gray sands and gravels	50 "	
	Hard calcareous bed with barnacles	5 "	
	Loose gray sands	100 "	
	Total		491 "
White shales with *Pecten peckhami*			800 "

Usually there are three layers of fossiliferous rock within the Temblor horizon, bearing typical Lower Miocene fossils such as the following:

(a) Loose sands with *Pecten discus* CONRAD
Astrodapsis sp.
Barnacles, etc.

(b) Yellow sands with *Mytilus mathewsoni* GABB
Ostrea titan CONRAD
Venus sp.
Zirphaea sp.
Pecten discus CONRAD
Pecten sp.
Chione sp.
Turritella ocoyana CONRAD
Agasoma sp.
Cancellaria sp.
Bulla sp.
Macoma sp.
Trochita filosa GABB
Numerous small gasteropods

(d) Thin white calcareous bed with *Chione temblorensis* ANDERSON
Ostrea titan CONRAD
Dosinia sp.
Crepidula sp.
Agasoma kernianum COOPER
Turritella ocoyana CONRAD
Neverita callosa GABB
Trophon kernensis ANDERSON
Conus owenianus ANDERSON
Oliva californica ANDERSON

Above the beds classed as Temblor there is a gypsiferous clay shale 250 feet in thickness, overlain by 50 feet of coarse gravels and conglomerates.

From the Cantua creek the Temblor beds have been followed southeastward to the vicinity of the producing oil wells and to within a short distance of Coalinga and to the Jacalitos creek. A large part of the strata formerly placed in a succeeding group has been found to belong to the Lower Miocene. The "Reef Bed" of the former paper is properly a part of the Temblor, and has yielded, on Sec. 20:

Hinnites (rel. H. giganteus) GRAY
Mactra densata CONRAD
Metis alta CONRAD
Pecten discus CONRAD
Arca montereyana OSMONT
Dosinia ponderosa GABB
Lucina borealis LAM.
Bulla sp.
Trochita sp.
Hemifusus wilkesana ANDERSON
Neverita callosa GABB
Astrodapsis merriami ANDERSON
Teeth of sirenians *(Desmostylus* sp.)

At the base of the Temblor beds is a pebbly conglomerate that serves to give emphasis to the abrupt change from the fine organic white shales upon which they rest.

It is easy therefore to recognize the unconformity that exists between the Temblor beds and the white or brown shales provisionally classed as Oligocene. This unconformity is that formerly described as conspicuous between the Coalinga beds and the Monterey shales. The pebbles of the conglomerate include metamorphic schists, jaspers, porphyries, serpentine, sandstone, and even some rocks that appear to have come from the calcareous concretions of the preceding series.

The Temblor beds contain the principal oil-yielding strata of the Coalinga field, and are well constructed to do so, not only stratigraphically and structurally, but also on account of the porous and unconsolidated character of the larger sandy members. The usual thickness of the Temblor beds is from 450 to 550 feet. In drilling for oil it has been found that various horizons are productive, the oil ranging through almost the entire thickness, though locally it is generally confined to one or two productive strata. Although in some parts of the field oil has also been found in strata both above and below the Temblor, the latter may be regarded as the chief source of the oil in most cases north of McKittrick.

In the McKittrick district the Temblor beds are known to be oil-bearing, but farther south they do not form the principal productive horizon. They occur, however, on the San Emidio and at Kern river, at the base of thick series of sandstones which underlie petroliferous beds. It is perhaps due to a change in the character of the strata above the Temblor that they do not everywhere contain the principal deposits of petroleum.

The Monterey Shales.—To the north of the Temblor ranch house, in western Kern county, is a thick series of white shales overlying the Lower Miocene and containing *Pecten peckhami* near the top and bottom. Its total thickness has been estimated at more than 5000 feet. This series of white shales has been referred to the Monterey, and there can be no reasonable doubt that at least a large part of the formation should

be so classed. From this locality these shales can be followed with more or less continuity northward to the Devil's Den and to near Coalinga. The Monterey shales and the underlying Temblor beds, as they occur along the hills to the south and east of Coalinga, have already been described in the former paper. To the north of Jacalitos, if the Monterey shales occur at all, they are in extremely reduced thickness or in modified form.

In the eastern part of the Coalinga field, certain beds occupying the stratigraphic position of the Monterey, have a thickness of only 250 to 300 feet. In their outcrop along the hills in the northern part of the field, they are variously colored, white, yellow, or red, and have at most points a decidedly sandy appearance. The "Red Hills" to the north of the property of the "California Oil Fields, Ltd." form an exposure that is conspicuous on account of its brick-red color. This can be easily followed northward to the Cantua creek and beyond, though its color is not persistent. This member of the Miocene was, in the former paper, described as "a yellow sand" and included with the Coalinga beds. In the wells drilled in the eastern part of the field this member appears as a bluish sandy shale which is commonly called the "Big Blue". The buff, yellow, or red color seen in the outcrops is probably due to the oxide of iron derived from the decomposition of certain iron-bearing minerals. With a good lens grains of serpentine and other talcous minerals can be detected in these shales. Their separation from the Temblor beds in the field to the north of Coalinga is for convenience in logical treatment rather than for emphasis of their stratigraphic prominence.

To the north of the Cantua creek these shales are even more sandy than farther to the south. It is not unlikely that there is a gradual thinning out of the Monterey shales from the Temblor valley northward to the Cantua creek, but this can not now be affirmed. South of the Temblor valley a vast series of white shale follows the range as far as Sunset and then swings eastward toward the San Emidio, becoming more and more sandy toward the east. No direct evidence is at

hand to establish its position in the stratigraphic scale, but it is supposed to be the continuation of the Monterey shales occurring north of Temblor. In the range west of Midway and to the south of Sunset they have an aggregate thickness of nearly 5000 feet and contain the usual lithologic peculiarities of the Monterey. As the Temblor beds are known to occur at San Emidio, there is a presumption in favor of these shales being properly the Monterey. To the south of the Temblor valley the structure of the Miocene rocks is that of a high anticlinal fold along the axis of the range, with a steep dip toward the Carisa valley and, near Sunset, toward the south. This anticline disappears in the vicinity of the San Emidio canyon.

The Coalinga Beds.—The uppermost member of the Miocene series is best characterized and most easily followed along the base of the hills north of Coalinga, but it attains its greatest stratigraphic development to the south and east of the Warthan creek. In the former paper, on account of its thickness and more varied fauna in the Warthan creek localities, it was made to include more strata farther north than should have been included. It is now proposed to restrict the name Coalinga beds to the lower portion of a series that is unconformably related to the older members of the Miocene. In the vicinity of Coalinga there are two somewhat different types of this formation occurring in the localities mentioned. As here restricted, the Coalinga beds contain from 500 to 800 feet of strata at the north—that is, between Coalinga and the Cantua creek, and from 1000 to 1500 feet in the field between the Warthan creek and Tulare lake.

These differences are due primarily to the conditions of deposition during the latter part of the Miocene period. Along the hills north of Coalinga this series begins with a basal conglomerate varying in thickness from 15 to 50 feet or more, and consisting of coarse pebbles and boulders often ranging in weight up to several hundred pounds. At Salt creek and northward to the Cantua, the weathering and faulting of this conglomerate has produced the effect of enormous thickness, which is deceptive. In many places, as north of the Cantua,

this basal conglomerate can be recognized and followed where other strata of the Coalinga beds can not be so easily identified. Above the conglomerate are thick beds of gigantic oysters, pectens, and barnacles that form a conspicuous feature of the formation. Usually there are two or more beds of shells from 6 to 20 feet thick included with 100 feet or more of sands. In Sec. 10, T. 19 S., R. 15 E., the oysters occur in four beds extending through nearly 200 feet of sandy strata. The shells are usually firmly cemented together and weather into a bold escarpment in which little else than huge oysters is to be seen. These beds of fossils in which oysters are the most abundant are often used in tracing the oil-bearing strata of the Temblor through parts of the field in which the latter do not show plainly on the surface. The species that characterize these beds include:

Ostrea titan CONRAD
Pecten crassicardo CONRAD
Pecten estrellanus CONRAD
Pecten (rel. *P. islandicus* MULL.)
Chorus carisaënsis ANDERSON
Chione temblorensis ANDERSON
Astrodapsis tumidus REMOND
Astrodapsis sp.

The basal conglomerates and the oyster beds with which they are associated overlie the red or variously colored shales described in the preceding section. There is little or no angular unconformity between the shales and conglomerates, though the abrupt change in the fauna and in the character of the deposits testifies to a change of considerable importance in the physical geography of the time.

A short distance above the highest oyster bed is a layer of sandy white shale 80 feet in thickness, and a sandy stratum immediately overlying the shale on the west side of Sec. 20, T. 18 S., R. 15 E. has furnished the following species:

Cytherea (callista) sp.
Chione temblorensis ANDERSON
Macoma nasuta COOPER
Pecten estrellanus CONRAD
Zirphæa dentata GABB
Lucina borealis LAM.
Diplodonta harfordi ANDERSON
Agasoma kernianum COOPER
Turritella sp.
Cancellaria sp.
Solen sp.
Trophon sp.

The faunas of the foregoing lists are generally characteristic of the Coalinga beds. Above these fossiliferous beds the formation is chiefly sand with little or no appearance of fossils.

To the south of Coalinga, or of the Warthan creek, the conglomerates and the associated oyster beds do not form a conspicuous feature of the formation, and in fact have not been directly identified. This is probably due to the fact that these beds were greatly thickened by the addition of sands during the time that an open channel connected them with the sea to the westward, causing conditions not favorable to the life and growth of oysters, but favorable to the development of some species not often met with elsewhere.

Along the Jacalitos creek the thickness of the Coalinga beds has been estimated at 1100 feet. There is an appearance of unconformity between the Coalinga beds and those above, while the line separating them from the beds below is not definitely established. Along the various branches of the Zapato Chino creek and eastward the Coalinga beds thicken still more until they attain an aggregate of 1500 to 1600 feet. They rest upon the white or rusty brown beds of the Monterey shales, with which there is little to mark an unconformity. As the Monterey shales here become sandy in their upper portion, the change from them to the Coalinga is not so abrupt as in the field farther north. There is not a great variation of lithological characters in the Coalinga as seen along the range south and east of the Warthan creek. There is, however, near the middle of the series, a bed of white volcanic ash from 12 to 16 feet thick, which is in some places conspicuous, but which is not always found, or at least is not always recognizable. It can easily be followed for three or more miles southward from the Warthan creek, a little east of Alcalde, and it appears again on the west fork of the Jacalitos at the Roberts ranch and also on the eastern tributaries of the Zapato Chino, on the Kreyenhagen ranch. Near Alcalde it is immediately underlain by a fossiliferous bed from which the following species have been obtained:

Pecten crassicardo CONRAD	*Trophon* (rel. *T. ponderosum* GABB)
Pecten estrellanus CONRAD	*Turritella* sp.
Chione (rel. *temblorensis* ANDERSON)	*Natica* sp.
Mactra (Spisula) catilliformis DALL	*Surcula* sp.
Mytilus mathewsoni GABB	*Volutilithes* sp.
Agasoma kernianum COOPER	*Ficus pyriformis* GABB (?)
	Tamiosoma gregaria CONRAD

The same bed some miles to the east upon the Kreyenhagen ranch contained, in addition to several of the preceding forms, the following:

Glycimeris generosa GOULD	*Scutella gibbsi* REMOND
Cardium, (cf. *C. quadrigenarium* CONRAD)	*Trophon* sp.
	Natica sp.

The forms most characteristic of the Coalinga beds in this part of the field are *Agasoma kernianum, Scutella gibbsi,* two species each of *Astrodapsis* and *Trophon,* and a *Chione.* These forms range through about 400 to 500 feet of sandy strata. Near the top of this zone there is often an abundance of *Ostrea attwoodi* and *Scutella gibbsi.*

The general and to some extent the specific resemblances of this fauna to that of the Temblor beds is of course evident; but a study of the strata above and below this horizon warrants the classification here proposed. The Miocene aspect of the fauna is unmistakable in the presence of such forms as *Agasoma kernianum, Chione temblorensis,* and the large species of *Cardium, Volutilithes,* etc.

A few hundred feet above these beds are the typical beds of the succeeding series, while below them are the Monterey shales and the typical Temblor.

The Coalinga beds have not as yet been followed continuously southward along the range beyond the Sunflower valley, though doubtless the task would not be impossible. They have not even been clearly recognized between the Sunflower valley and McKittrick. They form, however, a well defined and easily followed belt along the foothills west of the Midway district and to the south of Sunset. Northward this belt can be followed to a point a few miles north of Crocker Springs (Sec. 6, T. 31 S., R. 22 E.), and from thence it has been only

indirectly traced into the McKittrick district. West of the Midway district the Coalinga beds occur on both sides of the range, on the one side dipping toward the Great valley and passing below the Midway wells, and on the other side dipping to the southwest and under the Carisa and Elkhorn valleys. Their structure at this point is that of a denuded anticline, though it is not likely that the two slopes were ever quite horizontal. The thickness of these beds on both sides of the range is very great,—hardly less than 4500 feet.

Near their base they contain very coarse conglomerates and sandstones, among which may be found the characteristic fossils. The conglomerates often contain boulders of granite of immense size, some of them weighing 15 to 20 tons. The conglomerates at the base of the series range through several hundred feet of strata, of which they make up a large percentage. The species thus far found in these beds are those typical of the Coalinga, and include forms not found elsewhere in great numbers. They are more abundant on the western than on the opposite side of the range, though they have also been found on the eastern side. On the western slope near the locality commonly known as "the Dome", the following species have been found:

Pecten crassicardo CONRAD	*Tamiosoma gregaria* CONRAD
Pecten estrellanus CONRAD	*Chorus carisaënsis* ANDERSON
Ostrea titan CONRAD	

These beds have been followed northward along the western side of the range to the neighborhood of Simler. They pass in a synclinal fold below the Carisa valley and appear again on its western border. Near La Panza Springs an identical fauna has been obtained with the addition of such typical forms as:

Chione temblorensis ANDERSON	*Lucina borealis* LAM.
Trophon sp.	*Astrodapsis tumidus* REMOND
Turritella sp.	*Astrodapsis whitneyi* REMOND

and many other species. Not far away, at the crossing of the San Juan creek, these beds overlie an immense thickness of Miocene strata including both the Monterey shales and the Temblor beds. In the foothills of the Midway district this

series contains above the basal conglomerates a great thickness of clays and shales, some of which are diatomaceous and chalklike in their physical appearance.

The wells drilled for oil in the Midway and Sunset districts, although they probably derive their oil from this series of strata, do not penetrate to the basal sands for their productive horizon. In fact the better wells so far drilled have been less than 2000 feet in depth, and some of the oil has been found in strata not altogether sandy. Near Sunset the oil sands often outcrop in unmistakable exposures, sometimes showing well defined beds of bituminous sand, 30 to 60 feet or more in thickness. Near the refinery of the "Sunet Oil Company" a layer of hard sand immediately overlying such an exposure contains:

Crytomya californica CONRAD	*Solen* sp.
Tapes stanleyi GABB	*Macoma* sp.

Some miles farther to the east on Lobos and Muddy creeks the same formation has yielded, according to W. L. Watts[1]:

Crassatella collina CONRAD	*Tapes stanleyi* GABB
Glycimeris generosa GOULD	*Crytomya californica* CONRAD
Macoma secta CONRAD	*Macoma* sp.
Neverita reclusiana PET.	*Tapes* sp.
Dosinia mathewsoni GABB	

As this locality has also yielded *Pseudocardium gabbi* Remond, it is likely that the *Crassatella* given in the above list is identical with this species, since the forms are somewhat alike.

These beds in the Sunset and Midway districts overlie the immense series of white shales described in the preceding pages as Monterey, and the evidences of unconformity are all that could be asked for. Not only are there abrupt and great lithological changes, as well as a change in faunas, but an angular difference in dip and strike is clearly seen at many points along the range. From an examination of the lists here given and of the facts herewith presented, it will be seen that the Coalinga beds have been clearly identified in the foothills about the southern end of the Great valley, and this identification can be confirmed by many other facts that are not here presented.

[1] Bull. no. 3, Calif. State Min. Bur. pp. 38 and 40.

In their general features, faunal and other, the Coalinga beds resemble the San Pablo beds to some extent; and it is not impossible that in part the two may be equivalent, though, as will be shown later, it is hardly probable.

THE PLIOCENE SERIES

The Etchegoin Beds.—It is quite possible in many parts of the Mount Diablo range to recognize a marine series later than, if not always distinct from, all of the preceding. This is the series called in the former paper the "Etchegoin Beds". It must be admitted that no sharply defined line separates this series from that last described, though evidence is not lacking of a change in the physical conditions of their deposition.

Generally the strata of the Etchegoin beds are conformable in position with those of the Coalinga, and there is no great change in the lithology, such as is seen in some of the earlier formations. One of the most conspicuous characteristics of the later series is an enormous amount of bluish gray sand which is distributed throughout almost its entire length and thickness. In this feature these beds contrast strongly with the yellow or light brown sands of the Coalinga and earlier series. From its fauna it may be more easily recognized within limits, though there are species that continue upward from the Coalinga, and as yet there are not many species that individually are to be regarded as a sure sign of the Pliocene throughout the Coast or even the State. The exact thickness of the Etchegoin beds has not been measured at any point, though it has been estimated at a few places. West of the town of Coalinga it is hardly less than 1400 feet in the outcrop, but in some of the wells drilled along the base of the hills it must be somewhat less. Farther north, near the eastern part of the field, the thickness is greater, as seen both in the outcrop and in the wells, where the aggregate is not less than 2500 feet, and may be more. North of the Avenal wells, 15 miles southeast of Coalinga, the thickness is probably as great as 3500 or even 4000 feet. Bluish gray sands usually make

up as much as 20 percent of the aggregate thickness, to which their peculiar color and slightly greater induration give an exaggerated effect. The strata are essentially sandy throughout, though clays are abundant in their upper portion, especially north of Coalinga and in the vicinity of Salt creek and the Cantua. In the former paper the Etchegoin beds were divided into two portions called respectively, the "Etchegoin Sands" and the "San Joaquin Clays."

The sands of this series are commonly coarse in texture and often pebbly, forming beds of conglomerate. Many of the pebbles and sand grains are jet black in color, and mingled with these is a kaolin-like matter, perhaps a decomposition product from volcanic ash. The gray-blue color which is so noticeable in these beds may be due to these ingredients and to their manner of mixture. This color has not been noticed in either of the other series and has generally been found to be a safe index to the identity of the Etchegoin beds. It has been noticed not only in the Coalinga field, but at McKittrick, near Buena Vista lake, at Mount Diablo, and on San Pablo bay.

One or two fossil horizons are to be recognized in the Etchegoin beds,—one near their bottom and another some distance above; but whether these are persistent or not cannot be stated. The most clearly defined and best characterized horizon includes some 400 feet of strata in which there are sometimes several separate beds of fossils. This horizon occurs near the bottom of the series and, as seen in the outcrops in the hills west and southwest of Coalinga, contains the following:

(n)	Brown sands with fossils	15 feet
(m)	Clay shales	40 "
(l)	Sandstone with fossils	10 "
(k)	Bluish gray sands	35 "
Lower fossil horizon		
(j)	Gray sands, gravels, and clays	65 "
(i)	Sandstone with fossils	10 "
(h)	Sands and sandy clays	80 "
(g)	Bluish gray sands	40 "
(f)	Argillaceous sand	100 "
(e)	Bluish gray sands	30 "
(d)	Sandstone with fossils	8 "

Near the middle of this zone a fossiliferous sandstone (bed i) has yielded the following species:

Arca trilineata Conrad
Metis (Lutricola) alta Conrad
Mactra (Spisula) catilliformis Conrad
Pectunculus septentrionalis Midd.
Pecten oweni Arnold
Pecten estrellanus Conrad
Pecten crassicardo Conrad
Ostrea titan (?) Conrad
Saxidomus aratus Gould
Glycimeris generosa Gould
Diplodonta harfordi Anderson
Tapes stanleyi Gabb
Mytilus mathewsoni Gabb
Macoma inquinata (?) Desh.
Nassa californica Conrad
Natica lewisi Gould
Trochita costellata (?) Conrad
Scutella gibbsi Remond

In this horizon *Pectunculus* often occurs in great numbers, forming the dominant species. More than any other species it is persistent throughout the Coalinga field and is a survivor from the preceding series, in which it occurs in limited numbers.

The same fauna is found near the bottom of the Etchegoin sands along the tributaries of the Jacalitos creek and the streams farther east. It is everywhere characterized by the great abundance of *Pectunculus* and by *Pecten oweni, Scutella, Saxidomus,* and *Tapes,* by many other modern forms and by some living ones. Higher in the series the number and variety of *Pecten* species increase, and others which are abundant in the lower beds almost or quite disappear.

On the Zapato Chino creek and eastward a fossiliferous bed 1000 feet or more above the base of the series contains the following species:

Arca trilineata Conrad
Saxidomus aratus Gould
Pecten coalingaënsis Arnold
Pecten wattsi Arnold
Pecten etchegoini Anderson
Chama sp.
Ostrea sp.
Tellina sp.
Balanus sp.
Neverita recluziana Desh.
Nassa californica Conrad
Terebratella sp.
Clypeaster (Scutella) brewerianus Remond
Clypeaster (Scutella) gibbsi Remond
Sharks' teeth, etc.

A comparison of these lists with the lists of the Pliocene occurring at Kirker's Pass, published by Whitney[1] and others,

[1] Geol. Surv. Calif. Geol. v. 1, p. 32.

makes it evident that in fauna the beds are alike, if not in part identical.

The clays at the top of the Etchegoin series to the north of Coalinga constitute at least a third of their entire thickness, or about 1500 feet. They have a somewhat banded appearance, the different strata showing different zones of color. Thus far no fossils have been found in them north of the Warthan creek, though elsewhere they have yielded *Scutella gibbsi* and the teeth of sharks.

The Tulare Formation.—In the former paper the Tulare formation was described as a series of fresh-water deposits outcropping on the borders of the Great valley and overlying all the earlier deposits occurring along the range.

It is found in the vicinity of Coalinga, in the Kettleman hills, and southward along the western side of the valley as far as McKittrick, Buena Vista lake, and about the Tejon ranch. The fresh-water mollusks forming the fauna of these beds in the Kettleman hills and near McKittrick have been noted by W. L. Watts[1] as identified by Dr. J. G. Cooper. Shells of the fresh-water mollusks, *Anodonta* and *Goniobasis,* have since been taken from a prospect well drilled one-half mile north of McKittrick. They occurred in a layer of hard sandstone at a depth of 1000 feet from the surface. After penetrating this layer a strong flow of gas threw sand and stones from the well with great violence and with them many shells and fragments of these species.

The beds of the Tulare formation are described as having a thickness of 1000 feet and standing at an angle of 30° and more in conformity with the underlying marine Pliocene. In the former paper they were tentatively correlated with the Orindan and associated beds described by Dr. Lawson from the Berkeley hills.

While a complete statement of its equivalents can not be given here, it is important to remark that the Tulare formation should have its continuation not only throughout the Great valley, but that its counterparts should occur in all the

[1] Bull. Calif. State Min. Bur. no. 3, 1894, pp. 49 and 53.

neighboring and intermontane valleys of the state. It is not improbable that the equivalents of the Tulare will be found to include the thick delta deposits of the San Benito and Salinas valleys described by Dr. Lawson[1] and later by Dr. H. W. Fairbanks.[2] If this correlation is correct, then according to Dr. Lawson they should also include the marine beds of the Merced series, which are generally regarded as of late Pliocene age. The Tulare formation should also have its equivalents among fresh-water deposits of the Great Basin region, but a discussion of this topic can not be undertaken here. Undoubtedly there is a close relation between these deposits and the Pleistocene deposits and terraces described below. Just what that relation may be can not now be stated with certainty, but probably the time interval was short between the close of the Tulare epoch and the opening of the Pleistocene.

THE PLEISTOCENE RECORD

The evidences of the Pleistocene period in the Mount Diablo range are confined to the foothills and the marginal plains of the Great valley. As far as known, there are no stratified beds distinct from those of the Tulare formation appearing along the range that could be classed as Pleistocene, though there are abundant evidences that the period, at least in part, was one of submergence if not of inundation.

The Terraces.—Along the flanks of the range upon both sides, and about the southern end of the Kern valley, there are many elevated terraces and other remnants of ancient plains that must have circumvented the Great valley. These elevated terraces and mesas are not all of uniform height, and this fact may be taken as an evidence of a series, rather than of a single plain of base-leveling, though in some places the variations of level are only those of a somewhat varied topography rather than those of an absolute plain. These terraces may be seen to advantage about the lower Kern river, the

[1] Bull. Dept. Geol. Univ. Calif. v. 1, p. 153.

[2] Jour. Geol. v. 6, pp. 551-576; U. S. Geol. Surv. San Luis folio, pp. 11-12.

Tejon ranch, Sunset, McKittrick, Coalinga, the Cantua creek, Tesla, and Mount Diablo. Their elevation varies between 1200 and 1500 feet above the sea, or between 850 and 1000 feet or more above the floor of the Great valley. On the western side of the range their elevation is perhaps a little less, and there is also a greater variation throughout and a considerably greater extent, particularly about the head of the Salinas valley drainage. Along the foothills on either side of the range it is not unusual to see these terraces rising from 200 to 400 feet or more above the beds of the various stream valleys. These terraces are well exhibited in the lower hills in the vicinity of McKittrick, Midway, and the Kern river. Most of the oil wells of the McKittrick district are drilled upon the outer border of a large section of such a plain. Similar remnants and other evidences of base-leveling are plainly marked along the foothills about the southern end of the valley, especially in the neighborhood of the Tejon ranch, where a careful study would probably reveal a series of different levels. At the mouth of Grapevine canyon a terrace is cut at an elevation of 600 feet above the floor of the valley.

In the vicinity of Coalinga the terraces are well marked in many places both north and south, but especially in the foothills to the east of Alcalde and still further eastward in the Kettleman hills. Not only are these marginal remnants of the old base levels to be seen as terraces along the slopes of the higher range, but in many places in the outlying hills there are mesa-like ridges and flats strewn with the usual deposits of alluvial debris.

The base-leveling here described has acted upon and truncated each and all of the stratigraphic series of the range, but naturally its effects have been most pronounced upon the younger and softer strata. In the foothills along the southwest border of the valley the denudation has beveled and truncated the upturned edges of all of the sedimentary series from the earliest to the latest, including the Etchegoin and even the Tulare beds. To a less extent it has acted upon the older series, but usually their greater hardness has protected them from the destructive effects of denudation.

As to the exact period to which these results of base-leveling are to be attributed it is not easy to say with certainty. While presumably the greater part of it was accomplished during the Pleistocene, part has undoubtedly been the result of Pliocene denudation, and part has occurred later.

Whitney[1] has classed the buried river channels of the Sierra Nevada as belonging to the later Pliocene period, and in this view both Lindgren[2] and Lawson[3] have acquiesced. With these river channels may be correlated the Tulare deposits of the Great valley, while the development of the great Sierran peneplain most writers consider to have taken place later.

The Pleistocene Deposits.—The deposits of the Pleistocene consist for the most part of alluvial fills or other superficial deposits of boulders, gravels, and sands. These deposits are especially abundant at the southern end of the Great valley, where they have been noted by Whitney,[4] who mentions also the terraces about the Tejon ranch, though he does not designate them as such. The gravel and boulder deposits of the San Emidio canyon he also describes in part, and illustrates them by a sectional profile clearly showing their unconformable relation to the Tertiary formations and to the base-leveling of the adjacent foothills. In the neighborhood of the Midway oil district is a comparatively wide plain to the west of Buena Vista lake at an elevation of 600 feet above the valley, which is largely the product of alluvial filling and base-leveling of the surrounding Tertiary hills. The same class of facts is observable at McKittrick, Temblor, Carisa valley, Cholame, Peachtree, and elsewhere.

These deposits are never clearly stratified and are of the nature of alluvial accumulations on land surfaces, rather than in submerged basins. As in the case of the terraces, they have been considerably obscured by the products of later denudation, and it is not always easy to distinguish the Pleistocene from recent deposits. In many places, as at San Emidio,

[1] Geol. Surv. Calif. Geol. v. 1, p. 250 *et seq.*
[2] Journ. Geol. v. 4, p. 905.
[3] Bull. Dept. Geol. Univ. Calif. v. 1, p. 157.
[4] Geol. Surv. Calif. Geol. v. 1, pp. 188, 191 *et seq.*

Coalinga, and elsewhere, the Pleistocene peneplains have been extensively dissected by recent stream erosion and their deposits are left covering the mesa-like ridges or hills intervening between stream valleys. In such cases it is not unusual to find unstratified deposits of boulders covering the top of a ridge, or even resting cap-like on the crest of a conical hill. Among the boulders and pebbles of these deposits may be recognized fragments of all the earlier marine deposits of the range including metamorphics, Cretaceous sandstones, Eocene and Miocene limestones, and even many fragments of the immense oysters of the Coalinga beds as well as later fossils.

The fragments of *Ostrea titan* have often proved misleading to prospectors who have regarded them as a guide for the location of oil sands, with which, in their original position, they are often associated.

In those deposits that are most clearly of Pleistocene origin, it is apparent that there is an unconformable relation between them and the underlying formations, and that a period of erosion has intervened. In other words, much of the denudation and base-leveling has antedated the boulder deposits. These deposits are associated with, or more properly include, extensive beds of asphaltum at both McKittrick and Sunset; and in these asphaltum beds have been found the remains of a number of Pleistocene mammals, including the elephant, the horse, and an extinct species of wolf, doubtless representing a fauna belonging to the latter part of the Pleistocene period. It is evident, therefore, that it is to the early or middle epochs of the Pleistocene that the most extensive denudation is due.

Stratigraphic Relations

As a result of more extended study and closer attention to details it is found to be desirable to revise in some points the stratigraphic classification offered in the preceding paper; although as there stated, the essentials are fairly well shown. Undoubtedly there is evidence of unconformity between the

strata of all of the successive periodic series, and in some cases between different members of the same series.

The unconformity between the Chico and the Eocene is both stratigraphic and faunal when taken throughout their extent, though locally there is often some resemblance between them. But their relations have already been sufficiently well shown. If Oligocene strata are conceded for the Pacific coast, and especially in the formations of the California Coast ranges, then either they should occur in the Mount Diablo range, or their absence should add emphasis to the unconformity between strata of the Eocene and the Miocene. If, however, the Temblor beds are regarded as the lowermost Miocene, the evidence of an unconformity between them and the next older strata is significant, and it is clear that the change from one to the other is too abrupt to be called transitional. The strata immediately preceding the Temblor, however, while they are stratigraphically related to the Eocene in the central part of the range, are faunally and even lithologically like the middle Miocene in other parts of the Coast.

Probably the most noticeable interruption in the sedimentation of the Tertiary is that of the later Miocene—an interruption which intervened between the Monterey and the Coalinga epochs. The evidence of this unconformity is not of the nature of denudation so much as of abrupt change of sedimentation and fauna. This change is conspicuous throughout the range, and in the vicinity of Midway and Sunset shows in the heavy conglomerates, and between Coalinga and New Idria in the thick beds of huge oysters, pectens, and barnacles.

The stratigraphic relations of the Coalinga beds with the succeeding series is not so clear, though evidence is not lacking of some sort of change in the physical geography of the time. In some few places an angular divergence between the Coalinga beds and the Etchegoin has been observed, though this is not the rule. Whatever this change may have been, it was quite sufficient to inaugurate a considerable change of fauna and, on the whole, a noticeable introduction of more recent or modern forms. Two epochs, one marine and the other lacustrine, are postulated for the Pliocene; and while

their strata are mutually conformable and no clear evidence can now be offered to the contrary, it is not impossible that such evidence may be found when the fresh-water series shall become better known.

Deposits of Pleistocene age, in the form of alluvial gravels and other superficial and unstratified accumulations, rest unconformably upon strata of all of the older series, including those of the Tulare, signifying that a long period of denudation intervened between the latter and the late Pleistocene.

CORRELATIONS

The minor provinces or basins of the Pacific Coast Tertiary deposits have not yet been delimited, and the final correlation of strata studied in different parts of the coast region must await a fuller knowledge of geographical conditions. Even within the limits of California, provincial differences are apparent, and there is a liability to error unless a degree of caution is observed; still within limits some correlation is safe and desirable.

In the Salinas valley, Tertiary strata are known which can be satisfactorily compared with those of the Mount Diablo range; but in the Coast ranges to the west of the Salinas, bordering on the open sea, it is quite likely that both sedimentation and biological conditions were different.

Thus far the stratigraphy of the Eocene is only imperfectly known and has been less studied in the outer ranges than in the Mount Diablo range. Dr. Ralph Arnold[1] has given a brief and comprehensive sketch of the Eocene occurrences of the Coast, in which he has endeavored to recognize in each the various subdivisions as thus far described. In its more characteristic and better known portion, namely the Tejon, such an attempt is certain to be more successful and satisfactory than in other portions. The Tejon beds occurring in the Mount Diablo range are correlated with similar occurrences in all parts of the Coast, including Washington, Oregon,

[1] U. S. Geol. Surv. Prof. paper, no. 47, pp. 10-17.

California, and the peninsula of Lower California. Farther than this it is not now desired to follow them, though no doubt enough is now known of them to render it possible to recognize their equivalents in other parts of the United States.

In the same paper Dr. Arnold has mentioned supposed occurrences of Oligocene rocks at various points on the West-coast and has described a formation which he calls the San Lorenzo, which he doubtfully refers to this horizon. The fauna as there described is essentially Eocene, though it contains many species occurring in the lower Miocene as elsewhere known. It is quite likely, though not yet proved, that the Upper Eocene shales of the central Mount Diablo section should be correlated with the San Lorenzo. In the same way they may be correlated with the upper part of the Sespe formation described by Eldridge and Arnold[1] as occurring in the mountains of Ventura county, and tentatively classed as Oligocene.

The horizons of the Miocene can be safely correlated only within narrower limits, and it is not now intended to extend such correlation beyond the immediate environs of the Mount Diablo range.

Homer Hamlin[2] has described certain beds under the name "Vaquero Sandstone", and Dr. Fairbanks[3] and Arnold[4] have repeatedly employed the same name in various papers. The type locality from which the name is derived, however, lacks thus far any faunal or even stratigraphical description, and as it can not be found on any published or official map of the state or county in which it is said to exist, it is difficult to decide what portion of the Miocene rocks, if indeed any, should be classed under this name. The locality has been loosely defined as the eastern slope of the Santa Lucia range, or the western side of the Salinas valley, etc. Hamlin's description is quite too meager to identify its position in the stratigraphic scale, and aside from suggesting that it is not

[1] U. S. Geol. Surv. Water Sup. & Ir. no. 89, p. 14.
[2] U. S. Geol. Surv. Bull. no. 309, pp. 10-12.
[3] U. S. Geol. Surv. San Luis folio, p. 4 *et seq.*
[4] Proc. Am. Phil. Soc. v. 43, pp. 19-20; U. S. Geol. Surv. Prof. paper 47, pp. 18-19; U. S. Geol. Surv. Bull. no. 309, pp. 12-17.

the basal member of the Neocene, he does not define its place. In his attempt to describe the fauna of the "Vaquero Sandstone" his materials were taken from a series of sandstones overlying the Stone canyon coal vein on the west slope of the Mount Diablo range. Stratigraphically and faunally it agrees with the Temblor beds, as was determined by the writer before Mr. Hamlin's description appeared.*

Most of the strata that have been described under the name "Vaquero Sandstone", as far as known, represent a well characterized horizon of the Lower Miocene, and as such are without doubt to be correlated with the Temblor beds of the Mount Diablo range.

The Monterey shales occurring in the Middle Miocene of California have generally been called by that name; hence little is to be said regarding their correlation with the same in the Mount Diablo range. In general, however, there is a tendency to trust too far to lithological characters in their identification, and it is not unlikely that error has thus originated more than once in the application of this name.

The San Pablo beds described by Dr. J. C. Merriam as occurring on San Pablo bay, have not yet been sufficiently well exploited to enable a close comparison to be made. The fossils contained in the published lists of the San Pablo bay and Kirker's Pass localities are almost entirely those of the Etchegoin, rather than of the Coalinga. The species which chiefly characterize the lower series do not appear in the San Pablo as at present known, though it is quite possible that a greater resemblance will be found when both become better known. In the San Pablo at its type localities no mention is made of the abundant occurrence of *Pecten, Ostrea, Tamiosoma, Chione, Agasoma, Volutilithes, Chorus, Cancellaria, Turritella,* etc.

In the former paper the San Pablo, as known from its type localities, was correlated with the Etchegoin; and this seems to be its closest ally among the stratigraphic series farther

* As for the name "Vaquero" and its application to any strata outside of the type locality, it has no logical standing, and its claim upon accepted usage rests only upon assumption.

south, while in the Salinas valley and elsewhere beds that have been generally called San Pablo and otherwise correlated with it, are undoubtedly more closely related to the Coalinga. This is true of the Santa Margarita beds described by Fairbanks,[1] which also occur at La Panza Springs, Nacimiento river, and on the Estrella and San Lorenzo creeks. The type locality of *Ostrea titan, Tamiosoma gregaria, Pecten estrellanus, P. crassicardo,* and many other species described by Conrad, was the Estrella creek where Coalinga beds are abundantly fossiliferous. It yet remains to be shown that these beds are properly correlated with the San Pablo of the type localities, whereas the fauna of the Coalinga beds is unmistakable in them, as in the Santa Margarita beds.

Above the Coalinga beds occurring on the San Juan creek west of the Carisa valley, there are 2000 feet or more of strata, among which the Etchegoin beds and likewise the San Pablo have their place. The equivalents of the Coalinga beds and of the Etchegoin, which doubtless occur in other parts of the Great valley, have not yet been clearly recognized. The classification of the Tulare beds as late Pliocene and their relation to the Merced and Paso Robles formations have already been mentioned. The angle at which the Tulare beds stand in most of their outcrops is evidence of a post-Tulare uplift. It is not unlikely that, when all these formations are better known, it will be found that during the Tulare epoch the Kern-Tulare basin had a more direct relation to the Paso Robles and Merced deposits than that of synchronism.

It would be interesting to trace here the long history of crustal movements as they are illustrated in the Mount Diablo range; but that topic, along with many other interesting features of structure that can not now be taken up, must be reserved for future consideration.

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[1] U. S. Geol. Surv. Pub. San Luis folio, no. 101, p. 5-6.

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PROCEEDINGS

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DESCRIPTION OF A NEW SPECIES OF SEA SNAKE FROM THE PHILIPPINE ISLANDS, WITH A NOTE ON THE PALATINE TEETH IN THE PROTEROGLYPHA

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The correctness of the suggestion of the unity of the genera *Hydrophis* and *Disteira* has been most clearly brought out by an examination recently made by Dr. Thompson of the dental characters of nearly every known species of sea snake. In the species referred by authors to *Hydrophis,* as well as in those placed in the genus *Disteira,* the teeth behind the fangs normally are grooved. This grooving varies from deep and wide channels extending the entire length of the tooth and readily visible to the unaided eye, to the merest trace, present only at the base of the tooth and requiring for its demonstration a magnification of sixty diameters. In the widely distributed *D. cyanocincta* and *D. fasciata* one not rarely finds specimens in which the grooving is absent, or present on the

anterior teeth only. It is reasonable to expect that when a considerable series of any of the species is examined a similar variation may be found.

During the course of this examination it has been discovered that the *palatine* teeth of many of the species are grooved. The groove is on the antero-internal and on the internal quadrant of the tooth instead of on the antero-external quadrant, as in the maxillary teeth. This condition was first observed in the type specimen of *Hydrelaps darwiniensis*. An examination of a skull of *Naja melanoleuca* from Gaboon reveals the interesting fact that all the palatine teeth are grooved on their internal quadrants, and all the mandibular teeth are grooved on their antero-external quadrants. The palatine teeth are grooved also in the genera *Pseudelaps, Diamenia, Bungarus, Doliophis,* and *Elaps*. In *Dendraspis* they are solid.

Among a large number of marine snakes collected by Dr. Thompson at Cavite, Manila Bay, in 1906, are nineteen specimens which we are unable to identify with any of the described species of *Hydrophinæ*. This new species of *Disteira* we propose to name for the U. S. S. Cincinnati, to the crew of which the junior author is deeply indebted for much aid in collecting sea-snakes.

Disteira cincinnatii new species

Diagnosis.—This species is closely related to *D. fasciata* Schneider and *D. brookii* Boulenger. From *D. fasciata* it differs in being much stouter; in the narrow portion of the neck being shorter; in the lower average number of gastrosteges[1]; in the arching of the maxilla between the fang and first tooth, and the absence of an acute apex in front of the fangs; and in the less acute posterior angle of the frontal plate. From *D. brookii* it differs in the lower average number of gastrosteges; in the character of the scales on the sides of the body, which are mostly regular hexagons or are a trifle broader than long, where in *D. brookii* the upper and lower angles of the scales are very acute and the laterals are twice the size of the scales on the back. In *D. brookii* the snout is much broader.

Type.—Adult male. California Academy of Sciences, No. 15016. One mile N. E. of Cavite, Manila Bay, Philippine Islands. Dr. J. C. Thompson. December 20, 1906.

[1]Average in twenty specimens of *D. cincinnatii* is 361, while in twenty-six *D. fasciata* it is 417.

Description of the Type.—Head not distinct from neck, convex above; snout tapering and slightly projecting; eye large, its diameter equaling one and a half times its distance from mouth. Neck small, less than one-third greatest depth of body, slender portion short, less than one-fourth total length. Body compressed, width less than one-half depth, greatest depth about three and one-half times that of neck. Tail about one-tenth total length. Rostral nearly as deep as broad, breadth .0024M., depth .0021M.; sutures with first labial converge a trifle above, upper angle a little less than a right angle; facet for nasal .0012M., longer than facet for labial; lower border with convex median protuberance about one millimeter wide, fitting into deep concavity in mental; on each side of this protuberance are little concavities into which fit external superior angles of mental; portion of rostral visible from above about one *mm.* long. Nasal .003M. long, .002M. wide; anterior border formed by facets for rostral and first labial, latter shorter; mutual facet straight, .0023M. long; posterior borders of nasals nearly in straight line, if anything forming an angle with apex posterior; facet for second labial divided into two portions by suture running from anterior external quadrant of nostril outward and slightly forward to middle of second labial; nostril oval, long axis (.0008M.) parallel to suture of nasal and rostral plates; between nostril and prefrontal plate is a dent or suggestion of suture in nasal shield. Prefrontal broadly in contact with its fellow and second labial; length .0015M.; breadth .002M.; mutual suture .0009M.; anterior external angle acute; facet for frontal .0012M., a trifle longer than that for supraocular; facet for preocular .001M. Frontal one and one half times as long as broad, length .003M., breadth .0019M.; .003M. from rostral; supraocular facets .0014M., parallel; parietal facet .0014M.; posterior angle barely acute; anterior angle obtuse. Parietal .003M. long, .0025M. wide; mutual suture .0028M.; anterior angle obtuse; facet for superior postocular .0005M.; facet for anterior temporal .0014M., posterior .0024M.; posterior angle rounded, touching a single scale which lies between the azygos shield and posterior temporal. Preocular one, in contact with second and third labials. Postoculars two (normally one), superior a little larger. Temporals one followed by one; posterior larger, its suture with parietal nearly twice as long as that of anterior. Superior labials six; third and fourth entering eye; first nearly square; second greatly produced upward and backward, touching preocular and prefrontal. Mental .0018M. wide, .0007M. long. Infralabials eight; first in contact with its fellow; fourth very small; fifth largest. Genials in two pairs; subequal; anterior in contact; posterior partially separated by a single scale. Gastrosteges 360; distinct throughout; nearly all with two tubercles; on anterior part of body vary from one and one-fourth times to nearly twice size of scales in adjoining row. Preanals five; outer pair about three times as large as inner. Scales on neck in 28 rows, subimbricate, smooth, longer than broad, with truncate apex; on body, in 44 rows, oblong in a few median dorsal rows, majority on sides as broad as long, some a trifle broader than long; smooth on anterior portion of body, gradually acquiring a single tubercle and changing to hexagonal type posteriorly.

Head black; neck black with light vertical bars or incomplete rings, the first just behind the head; body black marked with lighter rings; tail black with light rings or vertical bars. The light bars or rings are much wider on the sides and below than on the back. The upper portion of each light ring is gray, while the lower half or more is clear yellow. The tubercles of the gastrosteges are black. There are 45 bands on the body and six on the tail.

Total length 752 mm.
Length of tail 77 mm.
Diameter of neck 6 mm.
Diameter of body 20 mm.

Variation.—The following table shows the variation in the more important characters:

Specimen No.	Sex	Length		Diameter		Scale Rows		Gastrosteges	Preanals	Preoculars	Postoculars	Superior Labials	Temporals	Bands	
		Total	Tail	Neck	Body	Neck	Body							Body	Tail
15001		474	45	5	15	27	40	333	4	1	1	7	1–1	46	3
15002		487	41	6	14	28	42	365	4	1	1	6	1–1	41	1
15003	♀	518	47	6	14	26	39	370	4	1	1	6	1–1	44	4
15004	♀	579	45	6	16	29	46	394	4	1	1	6	1–1	49	5
15005		587	61	6	15	26	41	345	4	1	1	6–7	1–1	43	4
15006	♀	676	69	6	16	24	38	323	4	1	1–2	6	1–1	41	5
15007		679	71	6	17	25	38	351	4	1	1	5–6	1–1 / 1–2	47	4
15008	♀	701	54	6	23	29	44	371	4	1	1	6	1–1	53	4
15009		717	74	6	20	26	42	358	4	1	1	6	1–1	54	5
15010	♂	718	80	6	21	27	44	365	4	1	1	6	1–1	46	4
15011		721	77	6	18	28	42	356	4	1	1–0	7–8	1–1	47	3
15012	♂	723	75	6	19	27	44	336	4	1	1	6	1–1	44	3
15013	♀	743	59	6	26	28	42	390	4	1	1	6	1–1	49	3
15014	♀	748	67	6	23	28	42	384	4	1	1	6	1–1	46	6
15015	♀	752	58	7	24	28	44	379	4	1	1	6	1–1	47	3
15016 Type	♂	752	77	6	20	28	44	360	5	1	2	6	1–1	45	6
15017		771	67	6	21	26	42	380	4	1	1	6–7	1–1	49	6
15018		786	77	7	20	28	42	355	5	1	1	7	1–1	42	3
British Museum	♂	651	66			28	41	320	4	1	1–2	7	1–1	50	3
Senckenberg		340	32			29	44	386							
Average						27	42	361	4	1	1	6	1–1	45	4

An accurate idea of the difference in the length of the tail between the male and the female is to be seen in the specimens No. 15016 and No. 15015: this is .019M. or exactly 25% longer in the male.

In No. 15002 the right anterior temporal enters the rim of mouth, and the left is fused with the sixth superior labial.

Fresh Coloration.—The following notes on coloration were made from fresh specimens.

No. 15001.—Body rings, above yellowish greenish gray, sides and below ochre yellow; demarcation not distinct, on about the ninth scale row.

No. 15002.—Head and neck shiny jet black, body dull black, tail blacker; on nape two oblong yellow spots; on neck and body forty yellow spots on each side, the majority confluent across back; on tail, one similar mark and a faint yellow spot behind it. The upper third of each spot on body is olive yellow, the lower two-thirds are orange yellow. These spots at widest part on body average one to one and one-half scales narrower than the black body-color between them.

No. 15010.—Head and neck for over 100 mm. shiny jet black; latter with canary-yellow bars, the first represented by two little oblong patches three scales behind the posterior temporals. The black bars on the body average nine scales long on the middorsal line, and four or five on the middle of the sides. The light markings are grayish olive yellow above and orange below; there is an abrupt line of demarcation on about the eleventh to twelfth row of scales. Tail dull black, the yellow clear, no olive above.

No. 15012.—Light markings olive gray above, light yellowish gray on sides, demarcation fairly sharp on about the eleventh row of scales.

Anatomical Notes.—In the maxilla are positions for two fangs, the inner a trifle the more anterior. There usually is one fang firmly cemented into place, and another nearly erect but loose. The fangs are compressed laterally and are about one millimeter long. The space between the base of the outer fang and the center of the base of the first tooth is a little more than the length of the fang. There are five teeth, about two-thirds the length of the fang; the grooving is on the anterior and outer quadrant.

The hemipenis (from specimen No. 15012) is bifurcate; with the organ everted and inflated the distance from an apex to the bottom of the division is .0004M.; sulcus bifurcate for a distance of .0026M. from apex. Apex and portion between rami of sulcus smooth. Papillæ border smooth area for about two indistinct rows. Spines begin about the middle of the

rami of the sulcus and extend to .013M. from apex; they are very uniform in size. There is a basal papilla on the smooth portion of the base of the organ opposite the sulcus; this is .003M. from the spinous area and .0155M. from the apex. This papilla is triangular, about .0012M. long, and its apex points toward the base of the organ and is free for about .0004M. We have found such a basal papilla also in *Lapemis hardwickii, Disteira ornata* and *Disteira cyanocincta.* Its presence in *Disteira stokesii* is indicated in the figure given by Cope. According to Cope's figure it does not exist in *Hydrus platurus* and we have found it wanting in *Laticauda colubrina.*

Habits.—This species is rarely seen in the daytime, and has not been observed floating on the surface during the day, as has been the case with *Disteira cyanocincta.* When it comes to the suface for air it swims directly upward at great speed, with the neck and anterior third of the body straight and the tail and posterior portion of body undulating, the head rises about a centimeter above the surface of the water, and then, instantly, the animal turns and dives vertically down out of sight. At night, in the area illuminated by the gangway lights, they are seen swimming slowly and horizontally at the surface, the neck nearly straight or curving slightly while the posterior third of the snake is in motion. All the specimens were taken with a dip-net from the gangway of the ship after dark. A light was hung over the side near the water, attracting crustacea and fish. There is no reason to believe the serpents were drawn by the light, for they would swim in and out of the illuminated area quite as though it were not there. They are fairly easy to capture and are extremely helpless when out of the water. The only food found in the stomachs of the series of nineteen snakes was four specimens of a small eel belonging in the genus *Muraenichthys.* These eels were submitted to Professor Charles H. Gilbert of Stanford University and pronounced by him to belong to an undescribed species which has since been named *Muraenichthys thompsoni* Jordan and Richardson.[1] The ship was anchored

[1]Dr. Gilbert writes us, "I regret we have no knowledge of its [*Muraenichthys thompsoni*] habits, and can only say that the probabilities are much in favor of its being a bottom form living in moderate depths (within fifty fathoms)."

in about twelve fathoms of water at the time these snakes were collected. Two females collected January 6, 1907, each contained three embryos. The heart of one embryo was found beating fifty-six times per minute, one hour after the death of the mother in alcohol.

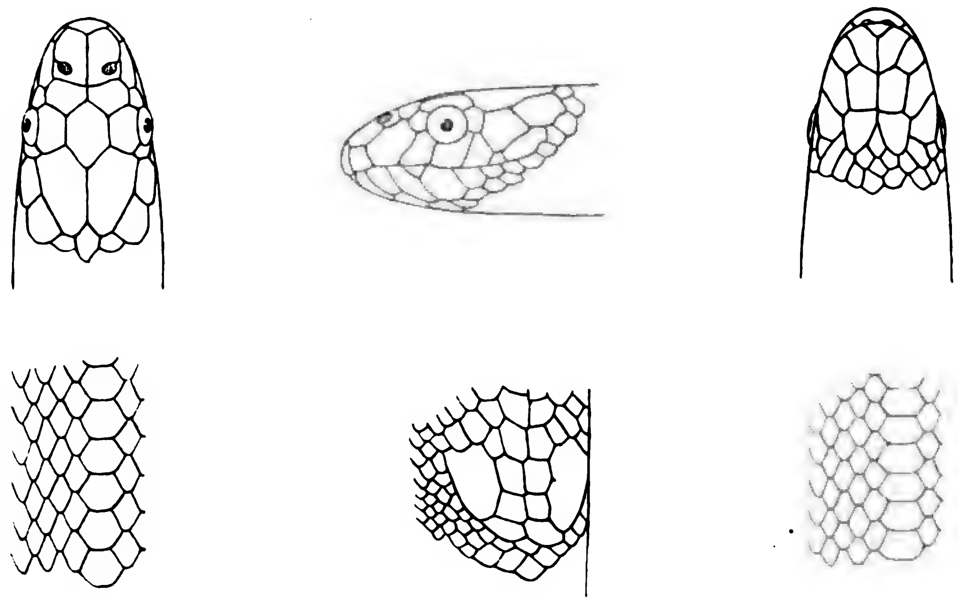
Material.—In addition to the eighteen specimens of this snake in the Academy's collection and the one presented by Dr. Thompson to the British Museum, we know of but one other specimen of *Disteira cincinnatii.* This is No. 9281.1a Senckenberg Museum and is mentioned by Boettger in his catalogue of snakes as *Hydrophis fasciatus* collected by Moellendorff at Manila.

CALIFORNIA ACADEMY OF SCIENCES,
December 7, 1908.

EXPLANATION OF PLATE I

Disteira cincinnatii new species

From the specimen in the British Museum. No. 08-3-19-1. Male.
Enlarged three times.



near neck anal near tail.

J. Green
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PROCEEDINGS

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NEW AND PREVIOUSLY UNRECORDED SPECIES OF REPTILES AND AMPHIBIANS FROM THE ISLAND OF FORMOSA

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The herpetological fauna of the island of Formosa has been represented in museums by but few specimens, and our knowledge of it has been correspondingly fragmentary. It has been, therefore, a source of much pleasure recently to receive from this island a collection of some two thousand specimens, beautifully prepared and carefully labeled as to localities. This collection is of extreme interest since, in addition to the species previously recorded from Formosa, it includes many species not hitherto known to occur in this island. Some of these are already known from examples secured either in the Riu Kiu Islands, to the north, or from continental Asia. Others, including a representative of a new genus, are new to science.

This paper is intended merely as a preliminary record of the new and unrecorded species. A more complete report upon the collection must await further study.

December 20, 1909

Ophisaurus harti Boulenger?

The presence in Formosa of a species of *Ophisaurus* is attested by a specimen now in the Taiwan Medical School. This specimen was collected, by the late Rev. Mr. MacKay, at Tamsue. Another specimen, collected at Shinchiku, was formerly in this museum, but has been lost. We have not as yet secured a specimen, but our collector states that individuals have been seen at Takao sunning themselves on a stone wall that borders a grove of screw pines.

The general relationship of the fauna would lead one to suspect that the *Ophisaurus* of Formosa is probably identical with Boulenger's *O. harti* from Fokien, China; but the notes which I have received concerning the specimen in the Medical School indicate that the Formosan lizard is distinct. The matter must remain undecided until a specimen is received for examination.

Takydromus septentrionalis Günther

The collection includes a number of specimens of this lizard from the Pescadores, as well as a large series from Taihoku, Koshun, Polisia, Taipeh, and Keelung, Formosa.

Takydromus sauteri new species

Diagnosis.—Dorsals large, in regular series; four pairs of postmental shields; one inguinal pore on each side; head and tail much elongate; color above bright green; upper lip and lower surfaces white.

Type.—California Academy of Sciences, No. 18001. Koshun, Formosa.

Takydromus kuehnei new species

Diagnosis.—Dorsals large, in regular series; four pairs of postmental shields; four or five inguinal pores on each side; head elongate; olive or olive brown above, with dark olive brown lateral streak, lower surfaces white.

Type.—California Academy of Sciences, No. 18002. Kanshirei, Formosa.

Polyodontophis collaris Gray

This snake, which previously has not been reported from Formosa, is represented in the collection by two specimens

from Kanshirei. Boulenger has recorded the species from Fokien, China.

Pseudagkistrodon new genus

Maxillary teeth thirteen, moderate, subequal, followed, without an interspace, by two extremely large fangs. Dentary not movable on articular. Mandibular teeth subequal. Head elongate, moderately distinct from neck. Eye large, with round pupil, completely separated from labials by a series of suboculars. Body stout; scales strongly keeled, in 23-24 rows, without apical pits. Gastrosteges rounded. Anal divided. Urosteges in two rows. Tail moderate. Hypapophyses present throughout vertebral column.

This remarkable new genus appears to be most closely allied to *Macropisthodon*. The maxillary bone is very short. The two long teeth lie horizontally and directed inward and backward, in such position that it is difficult to see how they can be used. Their posterior edges are sharp. The posterior portion of the palatine is much thickened. The quadrate is of extreme length. Externally the genus may be distinguished by the complete series of oculars surrounding the eye.

The type and only known species of the genus is:

Pseudagkistrodon carinatus new species

Type.—California Academy of Sciences, No. 18003. Formosa.

Description of the Type.—General form rather short, moderately stout, head elongate, tail moderate. Rostral twice as broad as deep; internasals a little broader than long, nearly as long as prefrontals; frontal longer than broad, nearly as long as parietals, longer than its distance from end of snout; supraocular in contact with prefrontal; all upper head plates roughened; loreal very small; eye bordered in front, below and behind by a series of nine small plates; temporals 3-4, strongly keeled; supralabials seven, fifth or sixth largest; infralabials nine, first in contact with its fellow; anterior genials smaller than posterior, in contact with first four infralabials; posterior genials separated from first gastrostege by one plate; scales very strongly keeled, in twenty-three rows, those of outer row nearly twice as large as those above; gastrosteges 141; anal divided; urosteges in two series, 64 and tip.

Head uniform brown above, yellowish white below; rostral, suboculars and supralabials yellowish white, the latter clouded with brown; a dark streak from rostral through nostril and eye to upper part of last labial. Body grayish or yellowish brown above; anteriorly with large, irregular, dark brown, sometimes black-edged, blotches separated

by angular pale areas. Sides with smaller alternating dark blotches. Posteriorly the blotches become much smaller and are disposed in transverse series of three. Lower surfaces yellowish white, dotted, clouded or marbled with dark brown.

Length to anus.............................. 543 mm.
Length of tail............................... 173 mm.

A second specimen from Toroku, Formosa, caught in 1905, is in the Sanitary Laboratorium, Formosa. A third specimen, received by the Academy, was collected at Mt. Arisan, Central Formosa. In coloration and form this serpent is, at first glance, strongly suggestive of *Agkistrodon acutus,* although on direct comparison they appear very dissimilar.

Natrix copei new species

Diagnosis.—Maxillary teeth about 21, gradually increasing in size posteriorly, not followed by abruptly enlarged ones. Head distinct from neck. Eye rather large with round pupil; lateral. Internasal shields broadly truncate anteriorly. Anal divided. Scales in seventeen rows. Temporals 1-1 or 2-2. Seven supralabials; third and fourth entering the eye. Gastrosteges 125-128. Urosteges 76.

Type.—California Academy of Sciences, No. 18004. Kanshirei, Formosa, April, 1909.

Description of the Type.—Eye rather large; rostral once and a half as broad as deep, scarcely visible from above; internasals shorter than prefrontals; frontal much longer than broad, longer than its distance from end of snout, shorter than parietals; loreal about as deep as long; one preocular; three postoculars; temporals 1-1; seven upper labials, third and fourth entering eye; four lower labials in contact with anterior genials; posterior genials much longer than anterior; scales in 17 rows, strongly keeled except first row where smooth or weakly keeled; gastrosteges 123; urosteges divided; anal divided.

Head nearly uniform brown; labials light with blackish edges. Upper surfaces of body and tail rather dark brown with a suggestion of a paler brown stripe on each side along the fourth, fifth and sixth scale-rows, and indications of small blackish spots medially and laterally. Outer row of scales lighter, clouded with slate. Belly yellow, with a more or less wedged-shaped blackish spot near the outer extremity of each gastrostege and urostege forming a distinct series along each side of the belly and tail.

Length to anus ....320 mm.
Length of tail ....54 mm. (broken)

This is a most clearly defined species, since the very small number of gastrosteges occurs in no other Asiatic mem-

ber of the group with seventeen scale-rows. I have examined specimens from Kosempo and Kanshirei, Formosa. It gives me much pleasure to name this species in memory of Professor Cope, whose studies have thrown so much light upon the relationship of the species of natricine snakes.

Elaphe porphyracea (Cantor)

Mr. Boulenger has recorded four specimens from Fokien, China. It is of much interest to find that the species occurs also in Formosa, where it has been taken at Kanshirei, Shinchiku and Giran.

Oligodon ornatus new species

Diagnosis.—Scales in 15 rows, anal divided; nasal undivided; postoculars two, supralabials seven, the sixth excluded from the labial margin; gastrosteges 161.

Type.—California Academy of Sciences, No. 18005. Shinchiku, Formosa.

Description of the Type.—Nasal undivided; portion of rostral visible from above much shorter than its distance from frontal; suture between internasals shorter than that between prefrontals; frontal a little shorter than its distance from end of snout, much shorter than parietals; loreal united with prefrontal; one preocular; two postoculars; temporals 1-2; seven supralabials, the third and fourth entering the eye, the sixth excluded from the labial margin; four infralabials, in contact with anterior genials; posterior genials but little smaller than anterior; scales in fifteen rows; gastrosteges 161, angulate laterally; anal divided; urosteges 37, in two series.

Light brown above, with nine transverse, dark brown blotches on the body and two on the tail. These blotches are edged with whitish yellow and are serrate in outline. Midway between these large blotches are transverse series of small brown spots. Head yellowish brown with dark brown markings consisting of a blotch on rostral and nasals, a cross band from prefrontal region through eyes to third, fourth and fifth labials, and a V-shaped band from posterior part of frontal across parietals and second series of temporals to angle of mouth. A large blotch, bifid posteriorly, on nape and posterior portions of parietals. Lower surfaces yellowish white, with quadrate black spots on many of the gastrosteges and irregular spots on the anterior urosteges.

Length to anus	292 mm.
Length of tail	51 mm.

The type specimen is the only one we have obtained, but in

the Taiwan Museum is one said to have been collected at Horisha, Formosa.

This species combines several of the characters of *O. templetoni* and *subgriseus* but seems to be distinct from both. It resembles *O. waandersii* and *melanocephalus* in the possession of an undivided nasal plate.

Callophis macclellandii (Reinhardt)?

In the Taiwan Library is a peculiar specimen of a *Callophis* which differs so much from the usual *C. macclellandii* that our collector, failing to secure a specimen like it, has sent us a photograph and some careful notes concerning it. The specimen in question was collected at Giran, Formosa.

The left maxilla has been destroyed. No small teeth could be made out on the right maxilla. There are one pre- and two postoculars; seven supralabials, the third and fourth entering the eye; frontal nearly as long as the parietal; temporals 1-1; genials nearly equal, anterior in contact with anterior four infralabials; scales in thirteen rows; gastrosteges 243; urosteges 29; anal divided; tail ending in a spine-like scale.

The head is black with a white band across adjoining halves of the sixth and seventh labials, the temporals, anterior half of parietals and posterior third of frontal. There is a black dorsal stripe covering the median scale-row and half of the adjoining row on each side. External to this is a brown stripe covering two and one-half rows, while the outer three rows are occupied by a black lateral stripe. This outer black stripe is interrupted by twenty-one white spots, each followed by a black blotch which encroaches on the fourth scale-row and on a gastrostege. These white spots are farther apart and smaller posteriorly. Gastrosteges with black spots and cross bars for about one-third of surface.

There is some doubt as to whether this specimen represents an undescribed species or merely an individual variation from the usual coloration of *C. macclellandii* but it seems best to regard it as the latter, at least until a specimen is received.

We have received *C. maccellandii* from Kosempo and Suishako, Formosa.

Amblycephalus formosensis new species

Diagnosis.—Loreal and preocular distinct; a long subocular separating eye from labials; prefrontal entering eye; scales smooth; eye bordered by four shields; gastrosteges 171; urosteges 80.

Type.—California Academy of Sciences, No. 18006. Kanshirei, Formosa, March 27, 1909.

Description of the Type.—Rostral as deep as broad; internasals about half the length of prefrontals; frontal little longer than broad, longer than its distance from end of snout, much shorter than parietals; a small interparietal; loreal deeper than long; eye surrounded by supraocular, prefrontal, one preocular, long crescentic subocular, and one postocular; temporals 2-3; supralabials seven, last two elongate, none entering eye; first lower labial not meeting its fellow; three pairs of large chin shields, first longer than broad. Scales smooth, in fifteen rows, vertebral row enlarged. Gastrosteges 171. Anal entire. Urosteges 80, plus tip.

Snout yellow; tip of head grayish brown dotted with black; an irregular black streak from supraocular to side of neck; side of head yellow, a row of small blackish spots from first lower temporal across last two supralabials to near tip of second gastrostege. Upper surfaces brownish yellow with dark brown or blackish transverse bars or blotches, usually interrupted along the spine, 47 to 50 on body and neck, and about 14 on tail. Below, yellowish white, sparingly dotted with black.

Length to anus..............................208 mm.
Length of tail..................................66 mm.

Agkistrodon acutus Günther

This interesting addition to the known fauna of Formosa is represented in the collection by three specimens from Koshun. In the Taiwan Medical School is a specimen from Shinchiku. Mr. Boulenger has recorded this species from Fokien, China.

Rana namiyei Stejneger

The collection contains numerous specimens which agree with Stejneger's description of the type from Okinawashima, Riu Kiu. These are from Kanshirei and Polisia, Formosa.

Rana latouchii Boulenger

A very large series of frogs from Kanshirei, Formosa, evidently represent this species, which Boulenger described from Fokien specimens.

Rana taipehensis new species

Diagnosis.—Allied to *Rana erythræa.* Vomerine teeth in two oblique groups between and extending behind choanæ; interorbital space broader than upper eyelid; tympanum very distinct, two-thirds diameter of eye. Fingers moderately slender, with expanded tips, first not longer than second. Toes slender, moderately webbed, three phalanges of fourth toe free; two small metatarsal tubercles; tibio-tarsal joint reaches nostril; thighs overlap. Distinct, rather broad, dorsolateral fold; a narrower lateral fold. Skin smooth. Bluish gray above; upper lip, dorsolateral and lateral folds white; loreal and tympanic regions, area between dorsolateral and lateral folds and stripe above dorsolateral fold blackish. Limbs with longitudinal dark stripes. Lower surfaces yellowish white.

Type.—California Academy of Sciences, No. 18007. Taipeh, Formosa.

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WATER BIRDS OF THE VICINITY OF POINT PINOS, CALIFORNIA

BY ROLLO HOWARD BECK

During the period between March 1, 1903, and July 13, 1910, while in the service of the California Academy of Sciences as chief field assistant, I spent considerable time in collecting water birds in the general vicinage of Point Pinos—Monterey Bay and the adjacent ocean. The precise periods of my activity were from September 8 to September 29, November 9 to December 31, 1903; March 1 to April 27, 1904; November 2, 1904, to February 25, 1905; February 13, 1907, to February 6, 1908; August 12, 1909, to January 22, 1910.

While my efforts were directed chiefly to collecting and preparing specimens, I availed myself of such opportunity as was afforded to make notes on the relative abundance and time of occurrence of the birds that came under observation, and the results are summarized in the following pages. When deemed expedient to supplement my own observations, I have freely incorporated those of Mr. Loomis as reported in his papers on California water birds, published in the "Proceedings of the California Academy of Sciences," 2d ser., v. 5, pp. 177-224; ibid., v. 6, pp. 1-30; 3d ser., Zool., v. 2, pp. 277-322; ibid., pp. 349-363.

With the exception of the omission of the vernacular and technical names of the subspecies, the nomenclature in the following pages conforms to the third edition of the A. O. U. Check-List.

In closing this brief prefatory note, I desire to make acknowledgment of the assistance rendered in the preparation of this paper by Mr. Leverett Mills Loomis, Director of the Museum of the California Academy of Sciences, and Mr. Edward Winslow Gifford, Assistant Curator of the Department of Ornithology.

1. **Æchmophorus occidentalis.** Western Grebe.—This species appears after the breeding season and occurs in varying numbers through the winter, being common at times. It lingers on into May. It prefers the quiet waters of Monterey Bay to the open ocean.

2. **Colymbus holbœlli.** Holbœll's Grebe.—In fall and winter this grebe is by no means a rare bird on the bay, especially in the harbor at Monterey and along the shore to Pacific Grove. Specimens obtained in April and early May are in high plumage.

3. **Colymbus auritus.** Horned Grebe.—The Horned Grebe is apparently less abundant on Monterey Bay than its congener, the Eared Grebe. It is also a later arrival from breeding grounds. Some March and April examples approach high plumage.

4. **Colymbus nigricollis.** Eared Grebe.—It appears during the middle of summer and remains through the winter, loitering on into spring. It is apparently the commonest representative of the family visiting Monterey Bay.

5. **Podilymbus podiceps.** Pied-billed Grebe.—The "Didapper" is apparently only an estray on Monterey Bay in the vicinity of Point Pinos.

6. **Gavia immer.** Loon.—Of the three loons found in this vicinity, this species seems to be the least numerous. However, it is tolerably common in the winter season. The earliest and latest dates of capture are October 15 and June 15.

7. **Gavia pacifica.** Pacific Loon.—Outnumbering all the loons, it is truly abundant at times late in autumn, through the winter, and in spring. In 1909, two loons, probably of this species, were seen as early as August 19. Great numbers pass Point Pinos on their way north at the end of May; stragglers remain into June.

8. **Gavia stellata.** Red-throated Loon.—Apparently the Red-throated Loon arrives from the north about as early as its

black-throated relatives; the majority appear to depart about a month earlier in spring. It is decidedly common at times.

9. **Lunda cirrhata.** Tufted Puffin.—Neither Mr. Loomis nor myself have observed the "Sea Parrot" in this immediate vicinity during January, February, March, and April. According to our observations it is a rather common visitant at intervals during the rest of the year.

10. **Cerorhinca monocerata.** Rhinoceros Auklet.—So far as I am aware, the earliest and latest occurrences in this vicinity are September 27 and the middle of May. It is a common winter bird; in 1907 it was numerous as early as October 14.

11. **Ptychoramphus aleuticus.** Cassin's Auklet.—Although there are no breeding places in the immediate neighborhood of Point Pinos, individuals occur in the height of the breeding season. Early in August there are inroads from breeding resorts. As a winter bird it is common, though perhaps varying in numbers in different years.

12. **Phaleris psittacula.** Paroquet Auklet.—In January, 1905, one was taken on the 14th and two on the 17th; all were several miles offshore. In January, 1908, twelve were captured on the 13th, one on the 15th, and one on the 30th. All were found several miles from shore. A dead one was picked up on the bath-house beach at Pacific Grove on the 28th.

13. **Synthliboramphus antiquus.** Ancient Murrelet.—That the experience of Mr. Loomis in finding this boreal auk common in December, 1894, and January, 1895, was not exceptional, is proved by my own observations. The species is certainly a common winter one. In 1907, the first seen were six on October 21; by the middle of November they had become common. In 1909, two were shot on September 2. Three stragglers were noted March 22, 1907.

14. **Brachyramphus marmoratus.** Marbled Murrelet.—A striking instance of variation in abundance and times of occurrence is furnished in this species. Flights of adults similar to those noted by Mr. Loomis at the end of July and in August, 1894, were not witnessed by me. Mr. Loomis found these birds common in the midwinter of 1894-1895, while I found them scarce in the midwinter of 1904-1905. In 1907, during the last of February and through March these murrelets were passing north, usually in pairs. A straggler was seen on April

2. An adult of the vanguard was taken June 22 and a young-of-the-year June 29. In 1909, through the fall and during December they were not uncommon. In January, 1910, their ranks appeared to be thinned, as only a few were met with.

A male, February 18, had assumed to a considerable extent the nuptial dress. March specimens of the Academy's series approach more nearly the complete attire. A male, March 26, is apparently in nearly full feather.

15. **Brachyramphus hypoleucus.** XANTUS'S MURRELET.—It is a remarkable circumstance that Xantus's Murrelet, a bird breeding in the subtropics, should occur in the vicinity of Point Pinos in midwinter with the Ancient Murrelet, a bird breeding in boreal regions. My records for the vicinity of Point Pinos are as follows:

From November 24, 1904, to February 4, 1905, Xantus's Murrelets were seen nearly every time a trip was made to the seaward of Point Pinos. On the 6th of December eleven were captured and on January 2 twenty were seen, ten of which were taken. They were common up to the day of my departure, February 25.

In 1907, a pair, flying northward, was seen on April 25; on July 29, several pairs were also seen winging their way northward; eleven specimens were prepared in August after the 13th of the month; September 2, fifty or more, mostly in pairs, were observed as they were flying out of the bay; they were common on September 6, one little company numbered half a dozen; a few were noted along to December 5.

During my stay in 1909 they were scarce.

Mr. Gifford informs me that the lining of the wings in the Academy's series of thirty-six specimens shows a complete intergradation between the white and gray aspects said to characterize *B. hypoleucus* and "*B. craverii*" respectively. Further, No. 10,197 has the lining of the wings chiefly white, but exhibits no white on the exposed portion of the inner web of the outer primary, and but little of the white tipping on the dark colored feathers on the sides of the body. No. 15,820 has the white lining of the wings and the white inner web of the outer primaries, and, when viewed superficially, appears to lack the white tipping of the feathers on the sides of the body. Closer examination, however, reveals under the surface new feathers with white tips.

These facts do not argue well for the validity of "*Brachyramphus craverii.*"

16. **Cepphus columba.** Pigeon Guillemot.—Only an occasional straggler occurs in winter. In March "Sea Pigeons" reappear, and become very common with the advance of spring. During the height of the breeding season they retire to their breeding places, forsaking the vicinity of Point Pinos save when on fishing excursions. By the middle of September they cease to be plentiful. The Academy's series of one hundred and thirty-six specimens fairly exhibits the various plumages incident to this species.

17. **Uria troille.** Murre.—Another instance of irregular occurrence in the winter season is afforded by this well-known resident species. During some years they are more abundant in December and January than in others. Visitors, apparently coming from nearby rookeries and bent on fishing, are common early in summer. The young-of-the-year, unable to fly, begin to arrive toward the end of July, the 24th being the earliest date of occurrence noted by me.

18. **Megalestris skua.** Skua.—The third edition of the A. O. U. Check-List ignores the specimen of the Skua obtained by Colonel Pike "off Monterey," at one time in the possession of the late George N. Lawrence and now in the American Museum of Natural History. It is therefore with no small degree of satisfaction that I record a male (No. 10,920 C. A. S.) shot by me on Monterey Bay on August 7, 1907.

19. **Stercorarius pomarinus.** Pomarine Jaeger.—Occurs in the vicinity of Point Pinos in every month in the year, but it is really common only during its passage southward in August, September, and October. Intermediate phases predominate. The extreme dark phase is not infrequent, but the extreme light phase is rare. The Academy's series of one hundred and seventy specimens represents all of these styles.

These jaegers pursue the gulls and terns, but seldom, if ever, molest the shearwaters with whom they often fish.

20. **Stercorarius parasiticus.** Parasitic Jaeger.—Not nearly as common as its larger relative, the Pomarine Jaeger; still it is by no means a rarity. It is most numerous in August and September. My latest fall date is November 10, when one individual was taken. The Academy has eighty-three specimens exhibiting the extreme and intermediate phases.

21. **Stercorarius longicaudus.** LONG-TAILED JAEGER.—The male mentioned by Mr. Loomis still remains the only specimen on record from this region.

22. **Rissa tridactyla.** KITTIWAKE.—One was taken November 22, 1904. A few were noted during December, 1904, and January, 1905. In February of the latter year they were common.

On my arrival in February, 1907, I found them common; for a time they were the commonest gulls of the vicinity. They remained until the latter part of April, several being seen on the 25th. In the following autumn, I saw one on the 6th of November; they became common in December and in January, 1908.

In the fall of 1909 and through the following winter, to the end of my stay on January 22, only a few were met with, the first on November 15.

23. **Larus hyperboreus.** GLAUCOUS GULL.—To the two specimens mentioned by Mr. Loomis, I am able to add a third, a white bird captured by Mr. Manuel Duarte in Monterey Harbor and mounted by him and now on exhibition in his store in Monterey.

24. **Larus glaucescens.** GLAUCOUS-WINGED GULL.—In this vicinity, as elsewhere on the coast of middle California, this gull is abundant in the winter season. My earliest date is October 25. In 1907, the majority had departed by May 10.

25. **Larus occidentalis.** WESTERN GULL.—Through most of the year this gull is abundant. Several sets of eggs were taken June 6, 1907, at Point Carmel, where a few pairs of these birds nest.

26. **Larus argentatus.** HERRING GULL.—While not as abundant as the two preceding species, still it is tolerably common during the winter season, arriving early in fall and lingering on into May.

27. **Larus californicus.** CALIFORNIA GULL.—As in other localities along the coast of middle California, this gull is abundant in winter. It makes its appearance in this vicinity toward the end of summer and departs late in spring.

28. **Larus delawarensis.** RING-BILLED GULL.—Found in fall, winter, and spring, but it is not common hereabouts. It appears to be a bird of the quieter waters, being more numerous at the mouth of the Salinas River.

29. **Larus canus.** Mew Gull.—I learn from Mr. Gifford that the characters ascribed to "*Larus brachyrhynchus*" are all to be found in *Larus canus*, which is a common winter bird on this coast.

30. **Larus heermanni.** Heermann's Gull.— Migration northward from the subtropics and tropics after the breeding season is well illustrated in Heermann's Gulls. They arrive from the south in force in June and July and with the advance of the season increase in numbers, at times rivaling the most abundant of the other gulls. They decline with the approach of their breeding season and in April and May are represented in this vicinity only by stragglers. By the latter part of January, 1908, the majority were white-headed.

31. **Larus philadelphia.** Bonaparte's Gull.—This is not a winter gull in the vicinity of Point Pinos. Three individuals December 9 and one December 24, 1907, are all I have to supplement Mr. Loomis's record of December 19, 1894. As a bird of passage, it is very common in later April and in May, about to the close of the third week. It is common in October and remains on into November.

32. **Xema sabini.** Sabine's Gull.—Ocurring in abundance in winter at Callao Bay, Peru, it is not surprising that these gulls pass Monterey in considerable numbers.

During the latter part of September, 1903, they were common off Point Pinos, journeying southward. Some eighty specimens were taken.

In 1907, about fifty were seen on July 22; they were common by July 30 and abundant through most of August; a few were noted along during September; the last one seen was on October 28.

In 1909, a few were observed during the last of August and through September. One was secured on October 6.

In returning to their nesting grounds, they apparently keep well offshore. I am able to report only eleven birds for the return-migration—all observed between the 15th and 21st of May, 1907.

In the Academy's collection there are one hundred and thirty-three specimens from this vicinity.

33. **Sterna maxima.** Royal Tern.—Mr. Loomis found the Royal Tern decidedly common at intervals during his sojourn in December, 1894, and January, 1895. I failed to find them

common during any of my visits, further illustrating the variable abundance in different years of the water birds of this vicinity.

34. **Sterna elegans.** ELEGANT TERN.—I have never met with the Elegant Tern in this locality. Mr. Loomis, however, took a number of specimens and saw others during September and October, 1896.

35. **Sterna forsteri.** FORSTER'S TERN.—Forster's Tern is a migrant in this vicinity, passing by in spring and fall. The precise status of this and the two following species has not been fully worked out in this State. The Academy's series contains seventy-eight California specimens.

36. **Sterna hirundo.** COMMON TERN.—That the Common Tern is of common occurrence in California has been entirely overlooked in recent years by ornithologists. In 1907, one was shot April 29; a few were seen during May, the last on the 18th. August 2 of the same year one was taken; through September they were common and a few tarried on into October. In 1909, a few were noted on the 27th and 30th of August. They were common through September of this year, and a few occurred in October. There are one hundred and nine Californian specimens in the Academy's collection.

37. **Sterna paradisæa.** ARCTIC TERN.—In passing Monterey in their migration to the antipodes, they occur inshore in varying numbers late in August and in September. The Academy's collection contains twenty specimens from the vicinage of Point Pinos.

38. **Sterna antillarum.** LEAST TERN.—While not actually seen in the immediate neighborhood of Point Pinos, these terns probably occur *in transitu;* as a small breeding colony is established at Moss, near the mouth of the Salinas River. August 25, 1903, young birds were just able to fly. The middle of June, 1907, nesting was commencing; by August 28 the young were awing.

39. **Hydrochelidon nigra.** BLACK TERN.—On the 9th and 16th of August, 1907, a few were seen flying southward. Two were taken on the 2nd and one on the 6th of the following September. On the 6th of September, 1909, two were noticed heading southward.

40. **Diomedea nigripes.** BLACK-FOOTED ALBATROSS.—Singularly, "Gonies" were apparently absent from the vicinity of

Point Pinos during my last visit, August 12, 1909, to January 22, 1910. In 1907, they were seen frequently from April 25 onward to August 27; then there was a hiatus until January 28, 1908, when a male was taken. My notes for 1904 and 1905 show only one occurrence, two individuals on January 30 of the latter year.

41. **Diomedea albatrus.** SHORT-TAILED ALBATROSS.—Strange to say this albatross has not been taken by me. Only on one occasion, December 12, 1904, did I see an albatross that might have been this species. Mr. Loomis, however, found it quite common in the winter of 1894 and 1895 and in the fall of 1896.

42. **Fulmarus glacialis.** FULMAR.—April 15, 1904, Fulmars were still common. But few were present during the winter of 1904-1905. In 1907, one was seen October 14, and in November they were common. Fully two thousand were observed on the 19th. Through December and the following January they were also common. In 1909, two were noted August 17 and a few through October; during November and December and in January of 1910, they were common, and fed largely on jelly fish.

"*Fulmarus rodgersi*" is included under *Fulmarus glacialis*.

43. **Daption capense.** PINTADO PETREL.—Col. Pike's specimen, now in the American Museum of Natural History, is the only one that has been reported from this region.

44. **Puffinus creatopus.** PINK-FOOTED SHEARWATER.—These shearwaters are common sojourners in this vicinity after their breeding season in the South Temperate Zone. Eight individuals seen February 27, 1907, probably belonged to the vanguard of that year. Before the end of November the majority take their departure, only stragglers remaining.

45. **Puffinus opisthomelas.** BLACK-VENTED SHEARWATER.—Coming to this vicinity after their breeding season in the subtropics, these shearwaters occur in great numbers, ranking second among the petrels in the scale of abundance. Their time of arrival varies in different summers. Their numbers also vary in different years. My earliest date of occurrence in 1907 was July 22, while in 1909 it was September 22. The last week of April witnesses their final departure for the breeding grounds.

46. **Puffinus griseus.** SOOTY SHEARWATER.—I have observed them in every month of the year. During the height of their

breeding season in the South Temperate Zone only stragglers are present. During the latter part of April they return in force, becoming very abundant in May and irregularly so in summer and early fall. In 1907, a gathering of fully twenty thousand was seen on November 4, a late date for such large numbers.

47. **Puffinus tenuirostris.** SLENDER-BILLED SHEARWATER.—Seemingly they are of regular occurrence in this vicinity in the return-migration to the Southern Hemisphere. In some years, however, they appear to be more numerous than in others, notably in December, 1895, as observed by Mr. Joseph Mailliard. December 2, 1907, was the day of greatest numbers in my experience, twenty-nine specimens being secured and others seen in a gathering of over two thousand Black-vented Shearwaters. The earliest occurrence coming within my observation is October 14, 1907, and the latest, January 30, 1908, a specimen being taken in each instance.

48. **Puffinus carneipes.** FLESH-FOOTED SHEARWATER.—In all, ten specimens of this shearwater have been taken by me in the vicinity of Point Pinos, adding another species to the list of birds of the American side of the Pacific. The specimens were obtained under the following dates: November 23, 1903; November 24, 1904; February 27, April 29, June 25, August 27, September 2, and November 4, 1907.

49. **Puffinus bulleri.** BULLER'S SHEARWATER.—The A. O. U. Check-List has rechristened this bird the "New Zealand Shearwater," and has defined its range as "New Zealand; north casually to California." Ten specimens have been taken by me in fall off Point Pinos, double the number recorded from New Zealand seas in Godman's "Monograph of the Petrels." The first recorded specimen from the Northern Hemisphere was taken by Mr. Loomis, and noted by him in the fourth of his California water bird papers.

50. **Priofinus cinereus.** BLACK-TAILED SHEARWATER.—The only record we have for this vicinity is the time-honored one of Lawrence, based on Pike's specimen, which is now housed in the American Museum of Natural History.

51. **Oceanodroma furcata.** FORK-TAILED PETREL.—In its migrations this petrel probably passes Point Pinos well offshore. Sometimes it comes within the shelter of the land. Such was the case in June, 1895, when it was plentiful in the

Monterey harbor. Again, early in November, 1903, sixteen were taken, and some others seen, on Monterey Bay, about a mile off Point Pinos.

52. **Oceanodroma melania.** Black Petrel.—September 14, 1903, a few were found on the south side of Monterey Bay.

In the spring of 1907, they were first met with on May 27, three being shot as they were winging their way northward over the ocean, two miles west of Point Pinos. Two were noted on the 28th and two on the 29th. On the 31st over a dozen were seen off Point Cypress. June 3 one was taken. June 22, about five miles west of Point Pinos, I saw a dozen or more, shooting three of them. June 25 one was captured. July 8, several miles northwest of Point Cypress, one was seen heading north. On the 22nd, in the same vicinity, about thirty were noticed. On the 24th they were quite common about eight miles west of Point Pinos; sixteen were captured. Six were observed on the 26th. August 12 and 14 single individuals were shot and August 19 half a dozen were seen. On the 21st and 22nd they were fairly common in the morning, feeding in current streaks two or three miles north of Point Pinos. Fifteen were taken on the 22nd. August 26 they were common. A few were noted on the 27th and 30th. September 2 a few were encountered about four miles to the northward of Point Pinos. On the 14th quite a number were seen in the same vicinage, searching for food. They were the last of the season, so far as noticed by me.

September 13, 1909, two were observed on the ocean about seven miles west of Point Pinos.

53. **Oceanodroma homochroa.** Ashy Petrel.—In 1907, a few individuals were observed on May 20. On July 24 several were seen, two of them being captured. They were well offshore, about eight miles west of Point Pinos. In this situation Black Petrels were quite common. August 21 a solitary individual, feeding with Black Petrels, was taken on the ocean two or three miles north of Point Pinos.

In the fall of 1909, scattering birds were seen in September, the first on the 13th. One was taken on the 20th. October 8 a specimen was shot, the only one observed during the month. On the 1st of November, I went out about eight miles west of Point Pinos. A low fog came in toward noon, with rising wind and sea, and a number of Ashy Petrels drifted in with it.

I put out some bait and secured about twenty in less than three hours. Two or three Fork-tailed Petrels put in an appearance, one coming close to the boat. On November 4, the day's trip extended six miles out from Point Pinos into a bank of fog. Here I saw four of these petrels, two of which were secured.

54. **Phalacrocorax auritus.** Double-crested Cormorant.—Monterey Bay in the vicinity of Point Pinos does not afford the same attractions for these "shags" as the land-locked bays of San Francisco and Tomales. During the time of the year when they are at large only occasional individuals have been observed. There is no rookery in the immediate neighborhood.

55. **Phalacrocorax penicillatus.** Brandt's Cormorant.—Brandt's Cormorants are abundant residents hereabouts. They nest on the islets along the shore south of Point Pinos. September 29, 1909, a few downy young were taken.

56. **Phalacrocorax pelagicus.** Pelagic Cormorant.—Common residents, but in some nesting seasons they appear to find more congenial fishing grounds elsewhere than along the south shore of Monterey Bay.

57. **Pelecanus erythrorhynchos.** White Pelican.—Two bands of half a dozen each, heading down the coast, were seen November 12, 1904, near Monterey.

58. **Pelecanus californicus.** California Brown Pelican.—Arriving from the south after their breeding season, they occur here commonly, remaining until the advent of the next season of reproduction.

59. **Mergus serrator.** Red-breasted Merganser.—In the period of general distribution, these mergansers are common in this vicinity.

60. **Spatula clypeata.** Shoveller.—The region under consideration is not a suitable one for river ducks. Incidentally, some have been observed as they were passing over. A male of the present species was shot December 24, 1907, in the vicinity of Point Pinos.

61. **Dafila acuta.** Pintail.—August 12, 1907, a male in eclipse plumage and a female were shot on Monterey Bay.

62. **Marila collaris.** Ring-necked Duck.—A drake is reported by Mr. Loomis in the second of his series of water bird papers.

63. **Charitonetta albeola.** Buffle-head.—Mr. Loomis has recorded this duck from this vicinity.

64. **Harelda hyemalis.** Old-squaw.—December 23, 1904, one specimen was taken. It was the only one seen by me.

65. **Histrionicus histrionicus.** Harlequin Duck.—June 6, 1907, an adult male in worn plumage was shot by me at Point Carmel. Mr. Loomis captured an adult male July 7, 1894, and a female May 25, 1897.

66. **Oidemia americana.** Scoter.—In 1909, a pair was seen November 1 and another pair November 4. On each occasion the male was secured.

67. **Oidemia deglandi.** White-winged Scoter.—Pensioners occur through the summer, keeping near the surf. About September 1 detachments from the north pass by. In November their ranks are reinforced. While not so numerous in winter as the following species, nevertheless they are common.

68. **Oidemia perspicillata.** Surf Scoter.—Flights of Surf Scoters occur in October and November. As winter residents, they are abundant. During the last of April, 1907, flocks were still passing north. As in the preceding species, disabled birds are found through the summer.

69. **Erismatura jamaicensis.** Ruddy Duck.—It is represented in this vicinity during the season of general dispersion.

70. **Branta nigricans.** Black Brant.—Although geese pass Point Pinos in some numbers, but one specimen was captured, a male Black Brant taken November 8, 1907. On the same day three flocks of Black Brant were seen. In 1909, three individuals of this species were seen on November 26 and eight on December 9.

71. **Dendrocygna bicolor.** Fulvous Tree-Duck.— Three were taken at the mouth of the Carmel River.

72. **Ardea herodias.** Great Blue Heron.—After the nesting season has passed, solitary individuals are occasionally seen flying over the bay and ocean or sitting on the rocks and kelp along the shore and even on the drifting kelp on the open bay and ocean.

73. **Nycticorax nycticorax.** Night Heron.—"Squawks" probably breed in the neighborhood. They occur about the lagoons and the call-notes of passing birds are heard in the evening.

74. **Rallus virginianus.** VIRGINIA RAIL.—Two or three were heard on December 16, 1909, at the mouth of the Carmel River.

75. **Fulica americana.** COOT.—Here, as elsewhere in middle California, "Mud-hens" abound during the winter season in suitable situations. Some spend the summer on the lagoons in Monterey and Seaside.

76. **Phalaropus fulicarius.** RED PHALAROPE.—As the shore was not systematically patrolled, I have not much to say of the shore birds frequenting the sandy beaches and surf-beaten rocks. Moreover, the immediate vicinity of Point Pinos does not afford congenial haunts for the denizens of the salt marshes and sandy beaches. However, in my search offshore for albatrosses and petrels, I encountered phalaropes in abundance.

Red Phalaropes arrive from the north early in August and occur through autumn and are common at times, extensive flights taking place. Some linger through December and January. There are fifteen specimens of such winter birds in the Academy's collection. I have not found Red Phalaropes in great force in spring, a few northbound travellers the last half of May being the only ones observed by me. I infer from his article on the Northern Phalarope ("Bird-Lore," v. 7, p. 273) that Mr. Chapman saw many Red Phalaropes on this coast at the end of May, 1902.

77. **Lobipes lobatus.** NORTHERN PHALAROPE.—The Northern Phalarope has been found in every calendar month of summer. Nevertheless, there is an interval of over a month between the departure of the last stragglers in June and the arrival of the advance guard in July. The height of the southbound movement occurs in August, when they are abundant. Some linger into November. Toward the end of April they reappear and become abundant during the first half of May. Afterwards they decline in numbers. Mr. Chapman notes (l. c.) an instance of arrested migration during the latter half of May.

78. **Pisobia bairdi.** BAIRD'S SANDPIPER.—Mr. Joseph Mailliard has recorded in "The Auk" (v. 15, p. 51) the capture of a male on the ocean beach south of Point Pinos, August 25, 1897.

79. **Pisobia minutilla.** LEAST SANDPIPER.—In connection with the record of the capture of *Pisobia bairdi*, Mr. Joseph Mailliard incidentally mentions the occurrence of a flock of *Pisobia minutilla.*

80. **Ereunetes pusillus.** SEMIPALMATED SANDPIPER.—Of this common California species, I have obtained but one specimen in this vicinity. "*E. mauri*" is included under *E. pusillus.*

81. **Calidris leucophæa.** SANDERLING.—They occur as migrants on the beaches of the vicinity.

82. **Limosa fedoa.** MARBLED GODWIT.—This species has been noted only during the exodus-migration.

83. **Catoptrophorus semipalmatus.** WILLET.—The Willet has been positively identified only during July and August.

84. **Heteractitis incanus.** WANDERING TATTLER.—Frequenting the surf-beaten rocks, these tattlers are common during both migrations. In the exodus-migration, they arrive in July. In the return-migration, my earliest date is April 20.

85. **Actitis macularia.** SPOTTED SANDPIPER.—Two females were taken on May 10, 1907.

86. **Numenius americanus.** LONG-BILLED CURLEW.—My only records are for the close of summer.

87. **Numenius hudsonicus.** HUDSONIAN CURLEW.—A single male was taken on April 8 and another on May 13, 1907. During the latter part of July of the same year some were seen going south over Monterey Bay.

88. **Squatarola squatarola.** BLACK-BELLIED PLOVER.—As in the case of the other shore birds, my notes are very fragmentary for this common species. On the 24th and 30th of July, 1907, some were seen heading south over Monterey Bay, about five miles offshore. In 1907, a male was shot on September 23, and in 1909, a male on November 22.

89. **Oxyechus vociferus.** KILLDEER.—Wherever the conditions are favorable, the Killdeer is to be found in more or less abundance in this vicinity.

90. **Ægialitis nivosa.** SNOWY PLOVER.—The Snowy Plover breeds commonly on the sandy shore.

91. **Aphriza virgata.** SURF-BIRD.—Careful observation on the seaward side of the rocky islets along this coast would probably show that the Surf-bird is not rare. There are six specimens in the Academy's collection secured by me in the vicinity of Point Pinos; a male taken May 10, 1907, and two males and three females taken August 5, 1907.

92. **Arenaria interpres.** TURNSTONE.—So far as I remember I have not taken the Turnstone in this vicinity. Mr. Loomis

and Mr. Joseph Mailliard (l. c.) have recorded solitary specimens.

93. **Arenaria melanocephala.** BLACK TURNSTONE.—Like the Pomarine Jaeger, the Black Turnstone occurs in this vicinity in every month of the year, stragglers and early birds from the north nearly or quite bridging the interval of summer. At times it is common.

94. **Hæmatopus bachmani.** BLACK OYSTER-CATCHER.—They were of frequent occurrence in suitable places on the coast below Point Pinos. One of the Academy's specimens from this vicinity was taken on June 5 and another on January 24, which would seem to indicate that the species is resident.

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THE NEOCENE DEPOSITS OF KERN RIVER, CALIFORNIA, AND THE TEMBLOR BASIN

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November 2, 1911

Preface

The first visit of the writer to the Kern River district was made in the spring of 1902; and the stratigraphic observations begun at that time have been extended from time to time each year as opportunity offered, until the summer of 1910. While this work was not begun nor carried on with the intention of publishing any of the results, yet the study has proved so interesting, and the results are in some respects so different from what had been anticipated after a considerable study of the Neocene deposits along the California coast, that it appears worth while to present some of the more general facts in the following paper.

One of the interesting points brought out by this study is the suggestion of a rather provincial character in the Neocene stratigraphy of the coast, which had been assumed to be uniform, at least within the limits of a single unit basin. It would be carrying the subject too far at the present time to attempt a close correlation of these Kern River deposits with any beyond the limits of their basin, but an attempt is made to point out the limits of the area within which such a correlation may properly be undertaken. The name used for this physiographic unit, the *Temblor Basin,* is the name used also for the more widely distributed and characteristic strata of the Neocene, that is the Lower Miocene, or Temblor Beds. There are other good reasons that may be brought out later for the adoption of this name, but for the present this one is perhaps sufficient.

The fossils and other material which had been collected from this region prior to 1906, had been largely donated to the California Academy of Sciences, and were lost in the great fire. Since then the Academy has made explorations in this field, and as a result has not only restored its collections, but has added considerably to our knowledge of the Kern River region. It is due to acknowledge in this connection the part taken in this work by Mr. W. H. Ochsner, Mr. A. G. Carpenter, and Mr. John P. Buwalda. Mr. Carpenter lived for several years at the electrical power-plant station situated on Kern River at the contact of the granite and the Neocene sediments.

He has made extensive and interesting collections in the Temblor beds at the base of the Neocene, and has made important donations of fossils to the California Academy of Sciences.

Mr. Ochsner and Mr. Buwalda each spent a considerable time studying the stratigraphy of the field, and making collections, the results of which have all been turned over to the Academy.

The identification of the fossil plants obtained from this field, in so far as identification has been secured, was made by Dr. Willis L. Jepson of the University of California.

It is proper also to mention in this connection the generous and co-operative attitude of Professor E. T. Dumble, Consulting Geologist of the Southern Pacific Company.

And lastly, the friendly interest taken in this work throughout by Dr. J. Perrin Smith, Dr. John C. Merriam, and Dr. Andrew C. Lawson, has been encouraging and gratifying in a high degree.

General Statement

One of the most striking features of the geology of the Great Valley of California is the relative lack of Cretaceous and Tertiary strata on its eastern border. Considering its synclinal structure, and the great display of strata along its western border, which range through all the periods from Cretaceous to Pleistocene, it is remarkable that there are so few occurrences of similar formations along the foot-hills of the Sierra Nevada. Certainly the streams coming into the valley, or basin, from the east during these successive periods must have contributed greatly to contemporaneous deposits; or rather, the quantity of detritus entering from the east could not have been small, and, under the assumed conditions of grade, would presumably be commensurate with the time-duration and the areas denuded. Naturally, therefore, larger collections of strata would be expected on the eastern than on the western border of the valley, and their absence is all the more surprising.

If thick deposits of strata were ever formed along the eastern border, but little evidence of them is visible. The basement rocks of pre-Cretaceous age usually come well down

to the present valley floor, and the few occurrences of later strata are in detached areas of only local extent. One of the most important of these areas is in the vicinity of the Kern River and its neighboring streams. Between White River and the Tejon valley for a distance of 50 miles there is a zone of low hills three to fifteen miles wide, occupying a position intermediate between the Sierra Nevada and the Great Valley. This zone of low hills consists almost entirely of Neocene strata resting in a gently inclined position against the granitic and metamorphic rocks of westerly Sierran spurs. In general the area is lenticular in outline, its widest part being in the vicinity of Poso Creek and the Kern River. The stratigraphic and faunal features of this area are the chief subject of the following paper, though it naturally embraces many related topics.

Review of Literature

Although the Tertiary strata in the vicinity of the Kern River were among the earliest in California to receive notice from geologists, and their fauna has long been believed to be exceptionally rich, yet comparatively little has been done to gather from this quarter the material they might furnish toward the development of our knowledge. At the close of this paper will be found a brief bibliography of the more important papers in which this area has been at least mentioned.

In 1853 a party of U. S. topographical engineers under the leadership of Lieut. R. S. Williamson, with Wm. P. Blake[1] as geologist, visited this region and made a camp for some weeks on Poso Creek, then known as Ocoya Creek. Blake made some search in the near-by hills, and discovered some marine invertebrate remains and the teeth of sharks. He made drawings of the invertebrate fossils, which were afterwards submitted to T. A. Conrad, and which were described by him[2] from the drawings. The sharks' teeth were likewise submitted to Prof. Louis Agassiz[3] for identification and description, and the conclusion was reached by both Conrad and

[1] Pac. R. R. Rept., v. 5, pp. 32-36.
[2] Pac. R. R. Rept., v. 5, pp. 328-329.
[3] Pac. R. R. Rept., v. 5, 313-316.

Agassiz that the formation was of Miocene age. Blake described in detail the beds with which these fossils were associated to the thickness of about 160 feet, though he inadvertently conveyed the impression that they were a part of a series at least several hundred feet in thickness.

After the discovery of oil on the Kern River, Mr. W. A. Goodyear,[1] and later W. L. Watts,[2] both mention these formations. Mr. Watts gives a meager description of the beds occurring along the river, and lists of the fossils contained in them. Incidentally he leaves the impression that the beds have a thickness of at least 2000 feet, though he does not directly say so. The fossils collected by Watts were submitted to Dr. J. G. Cooper for identification.

Dr. Cooper[3] noticed the resemblance of some of the species to Pliocene and living forms, and concluded that either several periods were represented in the Kern River section, or that the series could only be described collectively as Neocene. The fossils, however, all came from about the same horizon.

In 1902 Geo. H. Eldridge[4] published a brief statement of the surface geology and structural features of the Kern River oil-field, giving by far the best description of the same that had yet appeared. He believed that the section contained both Lower and Upper Miocene beds, and perhaps also Pliocene. The structure he believed to be, in the main, monoclinal over a wide area, and to contain minor undulations resulting in subordinate folds, in which the dip was commonly below 10°. The entire series of beds, he states, has the appearance of a shore deposit along the granite range of the Sierra. The wells of the Kern River field, according to Eldridge, are drilled into the upper part of the series, though he does not specifically say so.

In 1904 Dr. J. C. Merriam,[5] in a brief paper on the Fauna of the Lower Miocene, recalled the fact that at least some of the Kern River beds are of that age, chiefly on the evidence of such forms as *Agasoma gravidum*, *A. kernianum*, *Turritella ocoyana*, etc. Incidentally he called attention to the fact that

[1] 7th Ann. Rept. State Min., 1888, pp. 67-68.
[2] Bull. No. 3, Calif. State Mng. Bur., 1894, pp. 38-41.
[3] Bull. No. 4, Calif. State Mng. Bur., p. 51 et seq.
[4] Bull. U. S. Geol. Surv. No. 213, pp. 310-312.
Bull. Geol. Dept. Univ. Cal. v. 3, pp. 377-381.

in a wider study of the subject there appeared to be two distinct horizons of the Lower Miocene in California.

In 1905 F. M. Anderson[1] published a brief note on the formations along the Kern River, stating their thickness to be about 3000 feet, and giving a list of some 38 species, including many characteristic Lower Miocene forms. The species listed were all from the same horizon, within a vertical range of 200 feet, but more than 1000 feet above the base of the Neocene.

Meanwhile Mr. John Barker, whose residence was for some years upon Kern River, collected a large number of fossil sharks' teeth and other vertebrate remains from near the same horizon, all of which were donated to the California Academy of Sciences.

Later F. M. Anderson collected an equally large number of similar remains from the same horizon, including many undescribed species, all of which were likewise donated to the California Academy of Sciences.

In 1907 Dr. David Starr Jordan[2] published descriptions of many new species of sharks and other fishes found in the collections of Barker and Anderson, but without any attempt to determine the exact horizon of the Miocene from which they were taken. In these collections there were nearly 800 specimens, representing perhaps 15 species, most of which were sharks, though including also remains of rays and skates. All of these collections were lost in the San Francisco fire.

As will be seen from the foregoing review, the literature bearing upon these beds is fragmentary and scattered, and although the formations are interesting and important, no one seems to have found time to give them the attention they deserve. It is hoped that in the following pages the measure of their importance will be more fully shown, and some further information gathered from their study.

Topography of the Area

Viewed from a distance, the topographic features of the area herein described consist of low rounded hills, which taken altogether present the aspect of a gently sloping mesa inclined

[1] Proc. Calif. Acad. Sci. v. 2, pp. 187-188.
[2] Bull. Geol. Dept. Univ. Calif. v. 5, pp. 95-144.

toward the west. From a nearer view they are seen to be very much dissected by erosion. The larger streams coming from the Sierra meander through the zone of foot-hills in sinuous valleys along narrow flood-plains developed by corrasion in the yielding sediments. The intervening parts of the area are deeply cut by canons and ravines of varying gradients, which reproduce, in measures proportionate to their size, the features of the larger streams. As the general mesa-like surface rises gradually toward the east, so too, in going upstream toward the basement formations, the canyons and their tributaries become deeper, and the hills higher and steeper. The effect is that usually produced upon yielding sandy formations by recent but rapid degradation. The topography is similar to much that is found in the more arid belt along the western border of the Great Valley.

The principal streams are the Kern and White rivers, Poso, Caliente and Tejon creeks, all of which derive their waters from the older areas of the Sierra, and descend thence through deep and narrow gorges, and enter the zone of foot-hills in rapids, below which the grade is quickly lost. With the exception of the Kern River, these streams are without water during the drier portions of the year, while in the wet seasons they are often torrential. They cross the zone of foot-hills in relatively wide and shallow canyons, and have developed flood-plains that are in strong contrast to the narrow defiles in the older and harder formations. The canyon of Caliente Creek offers some interesting features which will be taken up later.

RIVER-TERRACES

The later erosional phases in the physiographic development of the region are well illustrated in the terraces along the several streams in the zone of the Tertiary hills. They are to be seen along all of the larger streams, but especially along the valley of the lower Kern. Within four miles of the point at which the river emerges from the granitic defile, five distinct terraces are to be seen above the present level of the river. Most of these terraces are shown in the plates at the end of this paper. Within the limits of these views they are found at elevations of 20, 60, 100, 160 and 350 feet above the level of the river. There are terraces at still higher levels, and rem-

nants of terraces, though they can hardly be called stream-terraces.

The highest river-terrace proper is at an elevation of nearly 850 feet above the sea, and on the south side of the river forms a broad mesa with an undulating surface. This may mark the level of a late Pliocene or Pleistocene delta, which will be referred to later.

The various terraces here described probably represent former flood-plains of the river, developed during the gradual elevation of the region. River gravels are strewn abundantly over all of these terraces, and even river boulders occur on some of the ridges 700 or 800 feet above the floor of the valley. These topographic features are fairly well shown on the Bakersfield special topographic sheet of the U. S. Geological Survey.

Base-Leveling

As a topographic feature the development of base-level terraces on the valley border is not so conspicuous within the Kern River area as it is at some points just outside of its limits. As shown in some of the photographs of the neighboring foot-hills, they form recognizable features along the southern border of the valley, and, as stated in former papers, they are present along its western border. Over the greater portion of the Kern River area, erosion has obscured or obliterated them to a considerable extent, though undoubtedly the mesa-like topography of the foot-hills is partly due to base-leveling, at least in its higher levels.

On the south side of the Caliente Creek at about the altitude of Bealville is one of the more noticeable of these terraces. Terraces that are believed to be the result of base-leveling truncate the edges of the older Miocene beds to the north of the Kern River and Poso Creek, and also south of the river as far as the Tejon valley.

Geology of the Foot-Hills

The geology of the area as shown on the maps includes, broadly speaking, two series of rocks; the Neocene Tertiary and the basement series. This fact has been already mentioned by most of the writers who have alluded to this locality, and

it requires no special notice here. The older series consists of granitic and metamorphic rocks, among which are hornblendic and other crystalline schists, phthanites and limestones. The contact between the older series and the Neocene is usually well defined, so that the boundaries are easily mapped.

There are a few isolated areas of Neocene which are evidently superficial, and also a few unimportant areas of the basement rocks exposed by erosion within the boundaries of the Neocene. Moreover, the Neocene deposits occupy some troughs in the basement rocks which appear to have been excavated in pre-Neocene times. The most important of these troughs is that of the Caliente canyon which will be described hereafter.

The Neocene Series

The Neocene deposits extend along the foot-hills of the Sierra from near White River southward to the Tejon valley, forming a zone of varying width, fifty or more miles in length. This zone narrows at each end, though more gradually at the south, and has its greatest width in the section along Poso Creek.

As a feature of great economic value this area includes the well known oil-fields of the Kern River, which are situated near the mouth of the shallow canyon of the lower Kern River. But it is not the design to give prominence to the economic features of the geology in this paper.

Structure of the Neocene

The Neocene deposits of the Kern River area were evidently laid down upon a floor of older rocks that had been much eroded. This fact is illustrated by the somewhat broken boundary, by the isolated areas of granite within the Neocene, and by the filling of pre-Neocene troughs by the basal beds of the Neocene. This latter feature is particularly well shown in the case of the Caliente canyon. To some extent the dip and strike of the basal beds conform to these irregularities, but this is not usually noticeable.

In the main, the structure of the Neocene beds is simple, and consists of a gentle dip to the southwest, which rarely exceeds 5° or 6°. The greatest dip is near the base in certain disturbed

localities, and the flattest is along the western border of the hills. There are a few local undulations that develop low anticlinal arches elongated in a northwest and southeast direction. One of these anticlines traverses the developed oil district of the Kern River, and, according to Eldridge, another is found farther north. Another is to be seen along the eastern border of the area just north of the Kern River, and may be followed to the northwest across Poso Creek. It lies a little to the west of the fuller's-earth mine on the road from Poso station to Granite. There is a corresponding syncline to the east of this, midway between the Granite road and Adobe canyon.

The evidences of faulting within the Neocene area are almost negligible, though such faulting has taken place. Faulting to a greater extent has taken place along the eastern margin of the area, following in a general way, and in part, the contact with the basement rocks, and extending also at right angles to it for a limited distance at one point at least.

The faulting along the margin has evidently been of the normal type, and was probably progressive, resulting in a displacement of at least a few hundred feet in some places, and much more in others. At Pyramid Hill, the lowest Neocene beds known within the area are left exposed at a considerable elevation, resting upon a floor of granite. Near Walker Basin Creek, beds of sandy ash, which are apparently of Lower Miocene age, are severed from the main area and left stranded at an elevation of 2500 to 3000 feet upon the granites, indicating a throw of 1000 feet or more.

The structure of the Neocene beds developed by this faulting is partially expressed in the Poso anticline previously mentioned. It seems probable that the faulting has been progressive, and *pari passu* with the corrasion of such narrow defiles as that of the Kern River; but this aspect of the subject cannot be fully taken up at present.

North of Poso Creek, erosion has greatly excavated the Neocene sediments along the line of contact, forming small deep valleys in which the strata are clearly exposed.

In the head of Adobe canyon and near Granite station, where the structure of the Neocene beds resting upon or against the basement rocks is well shown, they are seen to be almost

horizontal, or to dip gently westward at a low angle. In this respect they present a strong contrast to their counterparts on the opposite side of the Great Valley, where the lowest beds of the Neocene usually stand at a high angle against the basement series.

The average dip of the strata across the entire area in the vicinity of Poso Creek is less than 4°, and approximates 3° 30′. This is about the average along a cross-section nearly 10 miles in length, and, as shown later, it fairly represents the dip in the western side of the developed oil-field.

The entire series has in many places the appearance of stratigraphic conformity throughout, and evidence is often lacking of any great disturbance intervening between the beginning and the close of Neocene sedimentation. Both to the north and to the south of the Kern River, however, there is an evident overlap of the younger portion of the series upon the older. and even upon the basement rocks to the east. Along Caliente Creek and southward, the Neocene beds stand at a higher angle than elsewhere; and beds that belong to the upper part of the series rest upon the basement rocks. Northward, near White River, there is a similar overlap. Beyond the limits of this area the evidence of overlapping is unmistakeable, but within the area it took place by a process so gradual that the results are not striking.

There is no clear proof of an interval of erosion intervening; though the assumption of one might offer a convenient explanation for the comparatively small stratigraphic thickness as contrasted with similar beds near Sunset, Temblor and northward.

Thickness and Stratigraphy

On account of the excellent exposures of the strata, and from the fact that deep wells have been drilled in the western part of the area, the opportunity for studying the thickness and composition of the Neocene beds is exceptionally good. Two sections have been made across the area, and two or more deep wells have given a fair representation of the stratigraphy. One of the sections crosses the area north of Poso Creek; the other extends along the Kern River; and both show some peculiarities. The aggregate thickness of the entire series, as measured in the outcrop across the strike to the north of Poso

Creek, is quite 3300 feet, and may be more, assuming the beds to have been originally horizontal.

Near the Kern River, where the dip varies from 2° to 8°, the measurement of its different parts separately gave an aggregate thickness of 3250 feet; yet the apparent thickness may be somewhat deceptive because of faulting.

In the deep wells the thickness is naturally somewhat less, since their positions are farther from the shore line, and the section is also somewhat reduced by erosion, but these matters will be referred to later.

The Outcrops.—Within the area outlined, the sediments of the Neocene are prevailingly sandy in the outcrop, with only a moderate proportion of clay and organic shales, such as usually compose them in other parts of the coast country.

Toward the bottom of the series there are conglomerates, sands, and volcanic ash, making up near 600 feet of the lower portion. Higher up and extending above the middle of the series there are shales more or less sandy in the outcrops, or shales interstratified with sands, that make up in the aggregate a third of the series. Above the shales are sandy beds which become generally coarser toward the top, as will be shown later. It is thus possible, on the basis of lithology, to separate the combined series into three separate portions; but on other grounds a two-fold division has been here presented.

In the outcrops the clastic elements are prominent in nearly all parts of the series, and the first impression is apt to be that it is chiefly sandy. At the surface the beds are but little consolidated, as the results of erosion show. The harder beds are nearly all confined to the lower third of the series, and they are prominent only at the base and near the bottom.

The lithological character of the individual beds is probably not always persistent over wide areas, and it is not easy, therefore, to recognize the smaller stratigraphic units in widely separated localities.

Below is given a tabulated generalized statement of two sections crossing the area, and similar stratigraphic columns of two deep wells of the Kern River district for purposes of comparison.

Fossils have been found at several different horizons in the lower part of the series, but more especially at three separate

levels designated in this paper as Zones A, B, and C, which are shown in their relative positions in the following statement:

Poso Creek Section		Santa Fe Well, "Rasmussen," No. 28		Grace Oil Co's Well, No. 5		Kern River Section	
240′	Pink sands, gravels, etc.		Erosion.		Erosion.	Terrace gravels.	240′
				400′	Gravels and sands with water.	Gray sands, gravels, etc.	
	Gray sands, gravels, etc.	300′	Gravels, sands and clays.		Sands with interbedded clays, etc.		
975′	Green and brown sands, gravels, and beds of clay.	605′	Kern oil-measures, etc.	905′	Sands with oil and gas. (Kern oil-measures.)	Green and brown beds.	1260′
			Oil-sands.		Water-sands, oil-sands, etc.	Clays, sands, and gravels.	
						Sands and gravels with stains of oil.	
255′	Ashy beds, "fullers' earth," sands, etc. with marine fossils.	720′	Sandy blue clay and shale beds.	900′	Clay shale. "sticky shale," gas, etc.	Zone C. Sands, shells, sharks' teeth.	60′
	Ashy shales.		White sands and clays.		Sandy shale, clay shale, etc.	Clays and ashy shales.	700′
1125′	Fine white sands and clays.		Brown sandy shale, etc.			Yellow clays and sands.	
	Sandy shale with marine shells.	955′	Brown shale.			Zone B. Sands, marine shells.	100′
100′	Sandy shale, marine shells.		Brown sandy shale, etc.		Marine shells.		
					Organic shale.	Diatomaceous shale, sandy clays, shale, etc.	440′
350′	Arkose sand and rhyolite ash beds.	5′	Sand, salt water and marine shells.		"Lake of Mud."		
				961′	Sand and shale with oil and gas.	Zone A. Sands, marine shells.	160′
250′	Coarse arkose sand and gravels.	220′	Hard sands.		Shale with gas.	Sandstones, basal conglomerate.	300′
					White sand.		
3295′	Total	2205′	Gray shales, sands, and brown shale.	3166′	Total	Total	3260′
		5010′	Total				

Deep-Well Records.—The records of the deep wells shown above throw considerable light upon both the thickness and the stratigraphy, as well as upon the structure of the Neocene series, and deserve, therefore, more than a passing notice. Mr. W. L. Watts[1] gives the record of a well drilled on the Barker ranch upon the Kern River, which began in a stratum of shale near the top of "Zone B," and which was carried to a depth of more than 969 feet without reaching the base of the Neocene, though boulders are reported at 743 feet from the surface. Most of the strata described in the record are sandy clays and hard shales such as are found on the surface not far eastward. Drilling was still in progress at the time of this report, and later developed a strong flow of sulphur water, which presumably was near the base of the series. The flow of water still continues, and is characterized by its contents of H_2S gas, and alkaline sulphates and chlorides.

Subsequently the deep well of the Grace Oil Company[2] was drilled on Sec. 8, T. 29 S., R. 28 E. near the Kern River, in the western part of the district. The surface at this point has been reduced by erosion not less than 240′, and the well penetrated the formations to a depth of 3166 feet, reaching a bed of white sand apparently near the base of the Neocene, from which was obtained a strong flow of very salt water.

On account of the more than usually complete information furnished concerning the drilling and the formations of the Grace well, it is of more than ordinary interest. The following notes and extracts are taken from a written statement by Mr. F. J. Carman, who superintended the drilling of the well.

The upper part of the log is said to be not unlike other logs in the vicinity, and includes the usual clays, sandy strata, and oil-sands of the Kern River district. Oil-sands are reported at intervals below 1260 feet, but only in small quantity, or even with some doubt.

At 2206 feet a bed of sand with fragments of fossil shells is reported, and its position corresponds somewhat to that of "Zone B" of the Kern River section.

[1] Bull. No. 19, Calif. State Mng. Bur. p. 116.

[2] The log of this well with some others will be added at the close of this paper, and for those who desire to make a close study of the stratigraphy of the district they will be found valuable.

Mr. Carman says: "At 2260 feet a lake of mud was encountered; this was the soft top of a shale formation 888 feet thick. This shale was soft but not sticky, most of the pieces obtained showing distinct lamination, and all of it saturated with hydrocarbon gas which would burn at the mouth of the well."

"The change at 2260 feet was a distinct one, from alternating sand and shale to a continuous shale deposit of great depth, and of somewhat different character from the upper shales. From what Captain Barker told me I should judge that this same shale was struck on his ranch at about 1200 feet."

"The shale also carried occasional streaks of chert and limestone from a few inches to two feet thick. The shale itself was slightly calcareous, probably due to the infusorial remains. A high-power microscope showed these minute shells, though I do not know their names."

"Some of this shale from about 2600 feet was identical in appearance with a piece from one of the Santa Maria wells at about 2000 feet, though I do not imagine this identifies the formation. At places in this shale, notably just beneath the hard shells, small quantities of oil were observed; I should judge it was from 20° to 25° gravity."

"At 3148 feet soft, fine-grained, white sandstone was struck into which we drilled 18 feet." The drilling was then said to have been stopped, "by the strong current of salt water that began to flow as soon as we had penetrated a short distance into the sand."

"This water was quite salty, though not so much so as ocean brine. It contained no sulphates."

"This flowed gently over the casing. How high it would have risen above this I do not know."

"The sand we found at the bottom, * * * is very similar to that found a few miles east of Poso station."

"From 1100 feet to 1285 feet the sands contained mainly water. At this point 55 feet of extremely coarse sand and gravel was struck, heavily saturated with oil of 10½° gravity, and no water."

"The find of this stratum, containing no water, led me to believe that I was upon the summit of another oil-horizon, especially after passing through so much water above."

At a later date a well was drilled by the Santa Fe Railroad Company in the western part of the Kern River field near the center of Sec. 24, T. 28 S., R. 27 E. It attained a depth of only 2270 feet, and was then abandoned. The formations penetrated by this well were for the most part sandy beds with interstratified clays described in the log as "blue clays." Only a little oil-sand was reported above 1260′, and less still below that depth. Many of the sandy beds carried water which required frequent shutting off in drilling the well.

Most of the productive oil-wells in the Kern River field have penetrated only the upper member of the series, and but few have attained a depth of more than 1250 feet. The records show the beds to be mainly sand and sandy shale, which are separated by beds of clay distributed at intervals in the formation. Very little oil has been found below a depth of 1250 feet, though the deep-well records report small quantities at a much greater depth.

In 1909 the Santa Fe Railroad Company under the name of the Petroleum Development Company drilled a deep well, "Rasmussen No. 28," on the S. E. ¼ of Sec. 4, T. 29 S., R. 28 E., and at the time of this writing had not ceased operations upon it. Through the kindness of Mr. F. C. Ripley, superintendent of the company, permission was obtained to make use of the following facts and records.

In the upper part of the log the formations are chiefly clays and sands with the usual oil-sands of the district. Oil in paying quantities was not found below a depth of 905 feet from the surface.

At a depth of 2694 feet the drill entered a hard sandstone from which was obtained a strong flow of salt water. At 2805 feet a dark gray shale was reached which continued almost uninterruptedly for nearly 2000 feet. This formation of gray shale resembles very much the dark shales of the Eocene in the vicinity of the Tejon ranch, in the San Emidio hills. Fossils were brought up from a depth of near 2600 feet, including *Turritella ocoyana,* and *Chione temblorensis.* The sandy bed between 2694 and 2805 feet apparently marks the base of the Miocene.

As will be seen, the thickness of the Neocene series is here also somewhat reduced by erosion—probably by as much as 450

feet, including the gravel beds at the top represented in the bluffs south of the river.

The dip of the beds between the deep wells, Rasmussen No. 28 and Grace Well No. 5, is near 3°, and as calculated on a section more nearly normal to the strike, it must be as much as 3.5°.

Estuarine Conditions

It is clear from the foregoing descriptions that the Neocene deposits of the Kern River are largely marine. At least one prominent exception to this rule must be noted, and the facts presented in this exception are of more than passing interest. The pre-Neocene trough of the Caliente Creek, especially near the junction of the Caliente and Walker Basin creeks, is filled with sediments that are at least not altogether marine. More than 2000 feet of strata are exposed along the lower part of Walker Basin Creek, nearly all of which are either non-marine or brackish-water deposits; and some of the strata near the base are plainly of fresh-water origin. The series is almost entirely composed of coarse gravel and sand of a greenish drab color, partly unconsolidated, but in the main sufficiently hard to resist weathering. Much of the material is pumiceous and otherwise volcanic.

Near the base of the series are sandy clays of a soft and yielding character and of the usual greenish color, containing remains of land and fresh-water mollusca; and, higher in the series, similar clays containing leaves and stems of plants. Near the top a flow of basaltic lava some 90 feet in thickness can be followed for a distance of two or three miles. Above the lava, and forming the uppermost beds of the lower group, are about 190 feet of marine strata.

The whole collection forming the lower group dips southward at an angle of 20°-30°, as exposed on the northern border of the trough. The character of the sediments, their distribution, the character of their fauna, and the plant-remains found at various levels, all indicate that the beds are estuarine, and are either of fresh-water or of brackish-water deposition.

This view is strengthened by the position of the beds within a trough in the basement rocks, and also by the fact that, as

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followed toward the northwest, the beds pass into the normal marine conditions of the lower Miocene already described.

Overlying this brackish-water series above described are the beds of the Kern River group forming a wide overlap.

Divisions of the Neocene

In the foregoing descriptions it has been shown that, upon the basis of lithology, the Neocene series can be divided more or less satisfactorily into three groups, two of which are thick, sandy aggregates separated by a third, in which clays and organic shales form a prominent part, constituting probably half its volume. If, on the other hand, the division is based upon other criteria it is not easy to separate the two lower members, though the upper one remains distinct.

On the whole the most natural division accords with the data of paleontology, and as measured in the outcrops is roughly as follows:

		Gravels and sands,	250′
Neocene	Kern River Group.	Green and brown beds, gravels, sands and clays, without fossils, but including the Kern oil-measures.	1260′
	Unconformity		
	Temblor Group.	Lower Miocene; clays, ashy beds, shales, white and yellow sands with marine fossils;	1160′
		Sands, sandy ash-beds, pumiceous ash-beds, and conglomerate, with marine fossils.	600′
		Total Thickness,	3270′

The Temblor Group

Basal Member.—The basal division of the Neocene series, like the upper division, is essentially sandy; but, unlike the latter, the rocks are often considerably indurated, and sometimes concretionary. Fossil invertebrates are often abundant, and have doubtless contributed cementing material to the concretions and to other hard portions of the strata. Some of the lower beds consist largely of volcanic ash, pumice, and sand, as has been already noticed by previous writers, and in this paper. Basal conglomerates are visible in only a few places, but a stratum of at least 50 feet is exposed at one

point north of the Kern River. Conglomerates, sandstones, and ashy beds make up 350 to 600 feet of the series to the north of the Kern River. On the flanks of the granite along Comanche canyon, beds of coarse sand and conglomerate make up 250 feet or more; but it is probably not all exposed. Grávelly or pebbly beds can be followed southward to the Tejon valley, but positive statements cannot now be made concerning them.

In the outcrop the basal member is not always visible, but between Poso Creek and White River, where it is exposed, it consists chiefly of coarse arkose sand mingled with rhyolite ash. The lowest bed, 250 feet in thickness, is a coarse white quartz sand, usually unconsolidated, though locally becoming indurated to quartzite.

Above this is a characteristic aggregate of beds 350 feet thick, in which ash is much more conspicuous, and strata of ashy sand alternating with beds of white ash in which grains of quartz and dark mica form a minor part. Some of the beds are entirely of ash of a faint dirty green color, yielding reluctantly to erosion, and for that reason forming the capping of prominent narrow ridges with bold eastern escarpments between the drainage lines.

Between Poso Creek and the Kern River, where combined faulting and erosion have exposed the lower beds, there are basal conglomerates and concretionary sandstones near 500 feet in thickness, mainly detrital, in which ash is not prominent, though probably not absent. These beds are best exposed in Pyramid Hill where they are quite fossiliferous, containing many species of marine invertebrates, and the teeth and bones of many vertebrate species.

To the south of the Kern River these basal beds are not much exposed, or, if exposed, were not recognized beyond a limited distance. It is evident that as the basal beds are followed northward they lose more and more their detrital aspect, and become more and more ashy and at the same time less fossiliferous.

To the north of Poso Creek, marine fossils are to be found in many places in these lower beds, though they are not abundant. Immediately below, however, and sometimes in, the more ashy beds, the teeth and bones of marine vertebrates

are sometimes plentiful. Marine invertebrates, which are abundant south of Poso Creek, are much less abundant to the north.

On Caliente Creek, and about the junction of this stream with Walker Basin Creek, sands, gravels, and conglomerates make up a much larger part of the series, but the conditions here are in several respects local, as will be shown later. Volcanic materials make up a considerable part of the entire Temblor group in this locality.

To the north of the Kern River the concretionary beds of the basal member are usually more fossiliferous than other parts of the strata, and probably for that reason are harder and more resistent. In the weathering of the beds, however, the concretions usually disintegrate somewhat, often releasing the fossils in almost perfect condition.

As far as can be determined from well-records, this member of the Neocene series is much thinner in the western part of the field than in the outcrops; and this is not surprising, since the westerly stations represent points that were farther off shore.

Upper Member.—The upper member of the Temblor group, or the portion above the general level of 600 feet from the base, as shown in the outcrops and in the records of the deep wells, contains a smaller percentage of sand and other detrital matter, and a greater percentage of organic material than any other portion of the Neocene. And of the detritus present a greater portion is of clay and shaly matter.

In this member clays and shales probably form in the outcrop about 50 per cent of its volume, and of this percentage about one-half is organic. Some layers are chiefly composed of diatomaceae and other minute organisms. In the deep wells the sands are replaced by clays, and the strata are correspondingly reduced in volume, but more strongly characterized. The reason for this is to be found in the relation to the Miocene shore line. The percentage of organic matter in the strata is of course not readily known from the well-records, but that organic matter is present has already been shown.

Thick deposits of diatomaceous and other predominantly organic shales, such, for example, as the white siliceous shales

so characteristic of the Neocene in many parts of the coast region and in the Mt. Diablo Range, are almost absent from the deposits of the Kern River area. Microscopic organisms are not conspicuous in many of the strata examined, though in moderate numbers they are visible in many places.

At Barker's ranch on the Kern River, just below the beds designated as Zone B, there is an exposure of about 200 feet of white, chalk-like shale in which diatoms are readily seen with a lens, and there are a few other such outcrops north of Poso Creek; but there is in this area no body of strata comparable in thickness to the great beds of siliceous shale on the opposite side of the valley almost west of the Kern River. In place of such material, however, especially in the northern part of the area, there is a considerable quantity of white, or light-colored, ash, such as will be described in the following paragraphs.

Among the strata that may be especially mentioned are beds of a sandy clay-like rock which has been described as "fuller's earth." A critical examination of these beds and of their material has not been attempted, but, from a cursory examination of the rock and of the beds, it seems probable that the clay-like matter is residuary. The color, fracture, gravity, and other physical properties, and the appearance of the rock under a good lens, all conform to the characteristics of a sandy volcanic ash. It shows a decided ability to resist weathering, even after being mined. In color it is a light gray, with a faint greenish tinge.

An analysis of this material from an old "fullers' earth" mine opened on Sec. 14, T. 27 S., R. 28 E., published by the California State Mining Bureau,[1] gives the following composition:

Silica (SiO_2)	54.32
Alumina (Al_2O_3)	18.88
Iron oxide (Fe_2O_3)	6.50
Lime (CaO)	1.00
Magnesia (MgO)	3.22
Loss by ignit.	11.86
Alkali by difference	4.21
	99.99

[1] Bull. Cal. State Mng. Bur., No. 38, p. 275.

A sample of similar material taken from near the same place was analyzed by Dr. A. S. Eakle, of the University of California, and was found to correspond very closely in composition to a true volcanic ash with an admixture of quartz sand and some other foreign minerals. His analysis, given below, differs from the foregoing in a manner that may be largely accounted for in this way. With a good magnifier nearly all of the samples showed clastic matter of this sort mingled with the ashy products, and the sample analyzed was not exceptional, but fairly representative of the great mass of this rock. It was taken from an old mine a few miles north of Poso station on the road to Granite. Dr. Eakle's analysis follows:

Silica (SiO_2)	64.23
Alumina (Al_2O_3)	17.85
Ferric oxide (Fe_2O_3)	4.25
Lime (CaO)	4.01
Magnesia (MgO)	Trace
Potash (K_2O)	1.53
Soda (Na_2O)	1.98
Ignit.	5.33
	99.23

In the rock opened by mining there are casts of marine invertebrates, bones of marine vertebrates and the teeth of sharks. The lens reveals many minute scales of dark mica, and the confused granular surface of decayed felspathic matter and quartz sand. Several beds of this or similar material occur in this member of the Temblor, especially north of Poso Creek, where they form prominent outcrops at the surface, which are easily followed along their strike.

A few outcrops of sand are sufficiently bituminous to induce drilling for oil, which has been done in different parts of the district, but thus far without satisfactory results.

The fresh-water or brackish-water facies of the Neocene which was described some pages back, forms a local phase of the Temblor group. The difficulties to be overcome in making any division of the Temblor group upon the basis of lithological character become apparent when attempted in this quarter of the field. The more shaly portion is nearest the base, and the beds become coarser toward the top, though clays are distributed throughout the column.

Then, as will be shown presently, there is reason to regard the whole collection of fossiliferous beds as representing the whole of the Temblor group, though it is not proved that some part of the series has not been carried away.

The Kern River Group

The uppermost group of the Neocene, as far as known, is almost without fossils, and consists of sandy beds, alternating aggregates of sands and clays, and, toward the top, beds of gravel. These beds are well exposed in outcrop one or two miles east of the Kern River oil-field, and along Cottonwood Creek, and southward, and on the Caliente, and also north of the Poso stage-station on the road to Granite. Beds of gravel and conglomerate, and frequently large boulders, are characteristic of this group. Some of the boulders near Cottonwood and Caliente creeks are above a ton in weight.

The upper part of the group is usually gray in color, but the larger part has a characteristic pale greenish or sometimes yellow color, though it often contains thin strata of chocolate-brown sand or clay.

The entire group bears evidence of being a terrigenous rather than an organic deposit, as far as known from its outcrops and from the well-records of the Kern River district. What it may be beneath the valley floor can only be surmised, though very likely its organic component becomes more pronounced, and the detrital is reduced.

The thickness of the group varies somewhat in different parts of the area, though in general it is under 2000 feet. To the north of the Kern River estimates have generally resulted in placing it near 1260 feet. South of Cottonwood Creek a partial section was measured which had a thickness of over 1100 feet, and on Caliente Creek a calculation based upon the average dip showed a thickness of something more than 1500 feet. Its thickness is naturally greater in the western part of the area than in the eastern, where it has usually suffered from denudation.

The group often exhibits sudden alternations of condition, changing quickly from clays, shales, etc., to coarse gravels and boulders. Some of the boulders of granitic rock are so

large as to suggest glacial or other unusual conditions during sedimentation.

There is quite generally the appearance of stratigraphic continuity in the Neocene series, and at any one point it is not easy to detect any angular divergence in dip or strike between the Kern River and Temblor groups. When followed along the strike, however, there is conclusive evidence of overlapping and of unconformity between the two groups.

Just south of the Kern River, and also near White River, the Kern River group rests upon and covers in turn different members of the older group, and finally rests directly upon the granite. The same is probably true to the north of the Tejon valley.

Special importance is attached to the stratigraphy and distribution of this group from the fact that the productive oil-measures of the Kern River district are confined to it. From this fact it has been called the *Kern River group*. The oil-measures make up about one-half of the stratigraphic volume of the beds.

Very little oil, and probably no oil in commercial quantities, has been found in the Kern River field below the base of this group, though small quantities of oil and gas are often reported. Bituminous matter in small quantities has often been seen in some of the outcrops of the older group, but as indications of oil deposits they are generally negligible.

The age of the Kern River group is not readily told, except that it is younger than the Temblor, with which it is certainly unconformable, as already stated.

The only fossil remains that have yet been discovered in it are fragments of petrified wood, but aside from suggesting fresh water conditions, or perhaps those of shallow water, they are of little value.

The oil-measures furnish a sort of evidence, which is perhaps stronger than a suggestion, that the group should be correlated with the petroliferous beds at Sunset, Midway and McKittrick, but this topic will be deferred for the present.

Quaternary Deposits

Overlying all of the older formations of the lower Kern River region, including the basement rocks and the Neocene,

and resting more or less horizontally across their edges where they are upturned, are thick deposits of gravel of distinctly alluvial origin belonging to a former epoch. Their areal extent is difficult to estimate, but they occur along all of the larger streams and stream-terraces, and along the borders of the valley plain are blended with recent alluvial deposits of the Kern valley.

The most characteristic of these deposits have some elevation above the present stream beds, and from these they range upward in altitude to several hundred feet. A large area of these alluvial sands and gravels occurs along White River, and another about the lower portion of Caliente Creek; but these areas are probably among the more recent. Along the upper terraces of the Kern River are some of the older deposits. The more recent deposits are naturally the thickest, having suffered less from denudation. Near Bena, a small station on the Southern Pacific railroad, they form cliffs of horizontally stratified gravels nearly 100 feet in height, but probably these represent only the upper portion of the deposits, and their true thickness at this place is quite unknown. They rest in turn upon the upturned edges of both the Temblor and the Kern River groups, and clearly occupy a trough excavated in these formations prior to the epoch of alluviation.

These alluvial deposits vary in texture from coarse gravels to sands and clays, and have usually a rusty yellow color. For the most part they are incoherent, though near the summit a hard layer is often seen, which has served to protect the cliffs from reduction.

The denudation and excavation of the older groups prior to alluviation is interesting, as showing a relative elevation of the land surface, very probably above the present altitude; and the formation of alluvial deposits that are now elevated shows as clearly a corresponding depression of the land surface. Alluviation and terracing have doubtless been synchronous.

Faunal Features of the Series

The faunal contents of the Neocene series of the Kern River and its vicinity present some interesting and unexpected features. Blake's collections were probably made from the

lower fossiliferous beds of the series, but he was unable to arrive at any more definite conclusion than that the beds were of Middle Tertiary, or Miocene age. Whitney and Gabb came only to the same general conclusion as to their age. Dr. J. G. Cooper, after examining several small collections made by W. L. Watts, partly from the lowest horizon, though chiefly from one higher up, was able to classify the beds only as Neocene. Among the fossils from the vicinity of Barker's ranch he believed he had identified many living species, and evidently these influenced his determination of their age. Later J. C. Merriam expressed a belief that the beds containing *Turritella ocoyana* and two or more forms of *Agasoma,* etc., were of Lower Miocene age, and refers to the Kern River beds as examples of the same. It is due also to remember that Dr. Merriam recognized the occurrence of many species in these beds having a modern or recent aspect.

In accordance with the views already expressed in this paper, only the lower 2000 feet of strata can confidently be called Miocene, as only that part of the series is known to be fossiliferous. Within this range, fossils are found at different levels throughout the area, some species having the entire vertical range. *Dosinia whitneyi, Chione temblorensis, Pectunculus septentrionalis,* and *Neverita callosa* have been found at both the top and bottom of the fossil-bearing strata. *Pecten andersoni, Venus pertenuis,* and *Solen sicarius* have a considerable vertical range. But by far the larger number of species and individuals are found in a much more restricted range.

There are, as already suggested, three well-marked horizons, separated by intervals of more than 400 feet, which contain nine-tenths of the fossils and an equal proportion of the species. These horizons have been designated as Zones A, B, and C.

Zone A is that of Pyramid Hill on the divide between the Kern River and Poso Creek. It is apparently the horizon described by Blake, and the one from which he collected the species described by Conrad, and it constitutes the lowest known fossiliferous horizon of the series. The top of Zone A is not more than 500 feet above the base. The beds are somewhat concretionary and exceedingly fossiliferous.

Zone B is that of the Barker's ranch locality, best seen on the north bank of the river one mile above the old ranch house.

It is the horizon chiefly represented in the list of species published by the writer in 1905, and is also the horizon from which Dr. Cooper believed he had obtained many living species. Probably none, or only a few, of the species are actually living, though it must be admitted that the resemblance of many of them to living forms is more than superficial. Probably many of them are the lineal antecedents of forms now living along the Pacific coast. Zone B has a stratigraphic thickness of less than 150 feet, and may be generally taken as 100 feet, though some of the species are found a little lower.

Zone C is that exposed near the top of Round Mountain, two miles north of Barker's ranch, and also in the hills west of Round Mountain, locally known as the Shark-Tooth Hills. It is the horizon from which most of the sharks' teeth have been obtained, including those to which reference is made by Dr. Jordan.[1] ?

This horizon can be followed across the field for many miles, and can usually be identified by its characteristic white marl, by its abundant sharks' teeth, and by the fact that it forms the uppermost fossil horizon, and is overlain by the greenish-gray sands of the Kern River group.

On the following pages are given lists of the more common or characteristic species of the three principal horizons of the Kern River Neocene series. The fossils of Zone A were collected by W. H. Ochsner, A. G. Carpenter, and the writer from the south side of Pyramid Hill in 1909.

LIST OF SPECIES

Species from the Kern River section:	Miocene Fossil Zones		
	A	B	C
Arca montereyana OSMONT	×	×	
Cardium vaqueroënse ARNOLD	×		
Cyrena (Corbicula) dumblei ANDERSON	×	×	
Cytherea (Callista) mathewsoni GABB	×	×	
Cytherea sp.		×	
Dosinia conradi GABB	×	×	
Dosinia whitneyi GABB	×	×	×
Homomya sp.	×	×	
Leda oregona SHUMARD		×	
Mactra (cf. M. albaria CON.)	×		
Mactra (Spisula) (rel. M. falcata GLD)		×	
Mactra sp.		×	
Mytilus mathewsoni GABB	×		

[1] Bull. Dept. Geol. Univ. Cal., v. 5, pp. 95-144.

List of Species—Cont'd.

Species from the Kern River Section:	Miocene Fossil Zones		
	A	B	C
Mytilus (*small sp.*)	×		
Ostrea eldridgei Arnold	×		
Ostrea sp. (*rel. O. titan* Con.)	×		
Ostrea sp. (*small thin valves*)	×		
Pecten andersoni Arnold		×	×
Pecten bowersi Arnold	×		
Pecten magnolia Conrad ?	×		
Pecten nevadensis Conrad	×		
Pecten perrini Arnold ?	×		
Pecten sespeënsis Arnold	×		
Pecten sp. (*rel. P. estrellanus* Con.)	×		
Pectunculus branneri Arnold	×	×	
Pectunculus septentrionalis Midd	×		
Phacoides acutilineatus Conrad	×		
Phacoides richthofeni Gabb		×	×
Pinna alamedaënsis Yates	×		
Solen sicarius Gould		×	
Solen sp.	×	×	
Tellina ocoyana Conrad	×	×	
Tellina sp.	×	×	
Tevela inezana Arnold	×	×	×
Venus (*Mercenaria*) *pertenuis* Gabb	×	×	
Venus (*Chione*) *temblorensis* Anderson	×	×	×
Yoldia sp. (*rel. Y. cooperi* Gabb)	×	×	
Agasoma gravidum Gabb	×	×	
Agasoma kernianum Cooper	×	×	×
Bullia (*Molopophorus*) *anglonana* Anderson		×	
Cancellaria condoni Anderson		×	
Cancellaria dallana Anderson		×	
Cancellaria joaquinensis Anderson		×	
Cancellaria pacifica Anderson		×	
Cancellaria simplex Anderson		×	
Chrisodomus sp.	×		
Conus owenana Anderson	×	×	×
Crepidula praerupta Conrad		×	
Crepidula princeps Conrad	×		
Cuma biplicata Gabb		×	
Dentalium substriatum Conrad		×	
Dentalium sp.	×	×	
Epitonium (*Opalia*) (*cf. O. rugiferum* Dall)	×		
Nassa arnoldi Anderson		×	
Natica (*rel. N. lewisi* Gould)	×		
Neverita callosa Gabb	×	×	×
Oliva californica Anderson		×	×
Oliva futheyana Anderson		×	
Pleurotoma (*Clathurella*) *dumblei* Anderson		×	
Purpura lima Martyn	×	×	
Scaphander jugularis Conrad		×	
Sigaretus scopulosus Conrad		×	
Terebra cooperi Anderson		×	
Trochita filosa Gabb		×	
Trophon kernensis Anderson		×	
Turritella ocoyana Conrad		×	

Species cited by Blake as determined by Conrad from the Lower Miocene of Ocoya Creek:

Natica genticulata CONRAD
Natica ocoyana CONRAD
Scaphander jugularis CONRAD
Agasoma gravidum GABB (*figured but not named*)
Agasoma kernianum COOPER (*figured but not named*)
Pleurotoma transmontana CONRAD
Nassa arnoldi ANDERSON (*figured but not named*)
Sycotypus ocoyanus CONRAD
Turritella ocoyana CONRAD
Colus arctatus CONRAD
Crepidula prærupta CONRAD (*figured only*)
Tellina ocoyana CONRAD
Pecten nevadensis CONRAD
Pecten catilliformis CONRAD
Arca microdonta CONRAD
Dosinia sp.
Cardium sp.
Solen sp.
Venus sp.
Cytherea (*Callista*) *mathewsoni* ? GABB

Fossil Fishes determined by Dr. Jordan from the Lower Miocene of Kern River:

Carcharias antiquus AGASSIZ
Carcharodon branneri JORDAN
Carcharodon rectus AGASSIZ
Dalatias occidentalis AGASSIZ
Galeocerdo productus AGASSIZ
Hemipristis heteropleurus AGASSIZ
Heptranchias andersoni JORDAN
Isurus planus AGASSIZ
Isurus smithi JORDAN
Isurus tumulus AGASSIZ
Lamna clavata AGASSIZ

The species contained in the foregoing list are mainly from the top of the Temblor, or the horizon of Zone C, and were collected by the writer or by Mr. John Barker as before stated. In addition to the above species there are many remains of rays, skates, sword-fish, and other marine fishes and animals. Vertebrae and other bones of whales, and the jaws, teeth, and ribs of marine mammals are occasionally found. Teeth of sea lions and of *Desmostylus* have also been found among the fossils of Zone C.

According to Blake's statement, the species described by Agassiz were, with perhaps two exceptions, obtained from a lower horizon on Poso Creek; but as far as known to the writer, the most prolific beds are at the upper limit of marine shells. The beds of this horizon are probably the most per-

sistent in character, and can be followed farther through the field than any others that have been attempted. A prominent layer of white sandy marl with an abundance of vertebrate remains can be followed easily for many miles.

Mr. Charles Morrice has recently collected from a small area in this zone an enormous number—1500 or more—of vertebrate fossil remains, including the teeth of many species of sharks and skates, the jaws and teeth of sea-lions, bones of whales, etc. Some of the sharks are probably undescribed species. Teeth of a *Desmostylus* have been obtained also from the same locality. It seems remarkable that so many remains, including diverse species, could be assembled in so small an area, which, at the time of their deposition and burial, must have been considerably off shore. Probably they mark an epoch of abnormal destruction among marine veretebrates, possibly an epoch of violent volcanic activity accompanied by the fall of ash, etc.

As has been already stated, the teeth and other remains found at other horizons than Zone C, are often found just beneath beds of volcanic ash, or in beds in which ash makes up an important part.

As will be seen, the faunas of the three prominent zones already described belong to the lower division of the Neocene, and are characteristically Lower Miocene. The upper division as far as known is almost without fossils, and is barren of any forms that are serviceable for stratigraphic correlation.

Fossils from the Estuarine Beds

Among the invertebrate fossils occurring in the estuarine beds of Caliente Creek, Dr. Dall has recognized land shells belonging to the genera *Circinaria* and *Epiphragmophora*. In addition to these a species of *Corbicula* near C. *dumblei* occurs in great abundance in one or more beds near the top of the series.

No special effort was made to collect or to determine the land plants contained in these beds, though, along with ferns, etc., the following genera were recognized: *Salix, Platanus, Ficus*. Other genera, however, were observed and also collected.

Correlation of Deposits

In a recent paper on the Geologic Record of California,[1] Dr. J. Perrin Smith has made a tabulated statement of the recognized sedimentary groups of California, including a summary, and tentative correlation of the formations that have thus far been described in the Neocene deposits. This is undoubtedly the most concise and satisfactory statement that has yet appeared of the progress made upon the correlation of the Neocene in California, though it evidently leaves much to be settled. The standard column of the Neocene is still a debatable subject, and will probably remain so for some years.

As shown in former papers bearing upon the stratigraphy of the valley borders, and as shown also in the tabular summary of Dr. Smith, here reprinted, there are, in the Mt. Diablo Range taken as a whole, all of the horizons of the Neocene, or their equivalents, that are to be found in any part of the coast, or in other words, all that are required for a complete section; though there are few places, if any, in which they are all present in recognizable form. At one point the lower, at another the middle, and at still another the upper members of the series are more fully developed. In the Kern River region if all of the members are present, they have not been recognized, and there appears to be the same incompleteness of section.

While it is possible or perhaps easy to identify some of the beds with members of a standard column, it is at present not safe to attempt a complete correlation of the several groups in the Kern River Neocene with those even of the Mt. Diablo Range. There is great variability in both the lithology and the faunas of contemporary beds even within the limits of the basin here concerned. For example, the Neocene deposits on the west side of the valley near the Temblor ranch and near Sunset have a thickness estimated at more than 6000 feet, consisting chiefly of shales which are largely organic. The contemporaneous strata near the Kern River attain hardly more than half this thickness, and are mainly of sandy detritus, with beds of ash and a minor part of shale, not exclusively organic. On the west side of the valley the beds are fossilifer-

[1] Jour. Geol., v. 18, 1910, pp. 216-227.

ous in places, even to near the top; while on the Kern River side the upper beds are destitute of fossils, except for a few which serve little for correlation.

The problems of correlation appear to be such as can be solved satisfactorily only by reference to the physical geography and other conditions attendant upon Neocene sedimentation, and in the light of facts gathered from districts somewhat outside the one under discussion. Doubtless marine currents during Neocene times played no small part in the distribution of the materials, and hence with the stratigraphy and thickness of the beds, and possibly also with their faunas. But it is only by recognizing the entire extent and position of the particular basin of deposition and its physical history that we gain the view requisite for the problems of correlation.

THE TEMBLOR BASIN

As shown on the maps contained in this paper the basin of deposition did not conform either in extent or position to the Great Valley of California, but, as has been pointed out in former papers,[1] it included not only a portion of the Great Valley, but also the intermontane valleys to the west. This basin was subsequently somewhat roughly described and outlined by Dr. Arnold in a paper giving broad generalizations of the environment of the Pacific Coast Tertiary faunas.[2]

From evidences that cannot be fully presented here it is believed that the Neocene basin of the California Interior was bounded on the east by the Sierra Nevada, on the south and west by the Tehachipi and Santa Lucia ranges, and on the north by a low plain, in part skirting the Sierra, but in the main occupying the northern portion of the Great Valley. The exact position of the shore-line cannot be stated, but it probably crossed the Great Valley obliquely in a northwesterly direction, receding more and more from the position of the Sierran foot-hills as it is followed northward. It is unlikely that this shore-line held its place continuously throughout the Neocene, but more probably its locus was shifted somewhat

[1] Proc. Calif. Acad. Sci., 1905, 3d ser., Geol., v. 2, pp. 157-158; Proc. Calif. Acad. Sci., 1908, 4th ser., Geol., v. 3, pp. 6-7.
[2] Jour. Geol. 1909, v. 17, pp. 520 et seq.

by the diastrophic movements of the period. As will be shown later, the conditions, if not the area, of marine deposition were greatly altered during Mid-Neocene—that is Monterey—time by wide-spread disturbances.

As stated before, the Mt. Diablo Range divides the Temblor basin somewhat centrally. Around the several island cores of this range the Neocene sediments cluster more or less continuously in concentric zones. The thickest and probably the most normal, if not the most varied, development of the Neocene is about what is locally known as the Temblor Mountains, and it is this portion of the Mt. Diablo Range that is most central to the basin here described. For these reasons, and also because the oldest beds of the Neocene, those known as the *Temblor Beds,* more accurately than any others delineate the extent and area of marine conditions, the basin may be appropriately known as the *Temblor Basin.*

About this basin, as already described, the summits of the various coast ranges lift their heads as boundary or interior monuments, well fitted to commemorate the existence of an object so important. For this basin forms in truth one of the most important unit-areas of the California Neocene, and should be treated as such in any extensive and consistent study of the deposits.

It is not believed that the various coast mountains existed as continuous ranges during the Neocene, but rather as chains of disconnected islands intermittently bounding the basin on the south and west, and also dividing it somewhat centrally in the position of the Mt. Diablo Range. About these several islands, in the wide inter-island channels, in the narrower waterways, and in the inclosed sea, the range of conditions, when affected by ocean currents, was very great, both as to sedimentation and as to the distribution of faunas; and it is only in view of these facts that correlations can be advantageously undertaken, either of deposits within this particular basin, or of deposits occurring respectively in this and neighboring basins, or of either with the standard column of the California Neocene.

Below is given a tabulated statement showing in a general way the plan suggested for the correlation of the Kern River

beds with those of the Mt. Diablo Range, and with others throughout the area of the Temblor basin.

Mt. Diablo Range	Kern River Area
Tulare Group	Not Recognized.
Etchegoin Group	Kern River Group Gray water-sands; green and brown sands, clays, etc.; sands carrying oil, oil-measures.
Santa Margarita Group Monterey Group	Unconformity, or beds not recognized.
Temblor Group	Temblor Group Zone C., clays, ashy beds, and sands with marine fossils; Zone B, gravels, clays, sands with marine fossils, diatom shales, bituminous shales, etc., Zone A, conglomerate, ashy beds, sands with marine fossils.

In his recently published paper, *The Geologic Record of California,* Dr. J. P. Smith[1] suggests without comment a tabulated correlation of the Neocene deposits occurring in and about the borders of the Temblor Basin. While the plan therein proposed is not in entire harmony with the conclusions of this paper, it fairly represents the trend of opinion, and therefore, by his courtesy, is reprinted here with slight necessary alterations, the terms in parentheses being interpolated.

THE TEMBLOR GROUP[2]

From an inspection of the fauna of Zone A described in the preceding pages, there can be but little doubt as to its identity with the lowermost beds occurring at Temblor and at other

[1] Jour. Geol., v. 18, No. 3, pp. 216-227.

[2] Dr. Arnold and others have not hesitated to apply the term "*Vaqueros*" to the Lower Miocene beds of the Mt. Diablo range which have been previously described under the name Temblor. It should be remembered, however, that the name "*Vaqueros*" has not yet any well-founded claim upon scientific or technical usage aside from its introduction into the literature of the U. S. Geological Survey. It has not yet had either a faunal or a stratigraphic description that could logically entitle it to recognition, nor has any such description been claimed for it. Its use in the literature of the U. S. Geological Survey is without reference either to logic or to the rules of precedence, and has in fact only an arbitrary basis for its support. It is hoped that its use will be discontinued.

Kern (County)		Coalinga	
	(Tulare)	Tulare	Lake beds · Pliocene fa with som brackish-wat
	(Base of "McKittrick Formation")	Etchegoin formation	Beds wit Pecten wat and P. coalinga
	(Santa Margarita)	Coalinga formation	Jacalitos b with Pecten ow
			Beds wit Tamiosom gregaria, Ost titan, an Pecten estrell
Monterey	Bituminous shales		Doubtfully re to the Monterey
Ocoya Creek beds	Barker's ranch beds with Agasoma barkerianum Agasoma kernianum and Pecten andersoni	Temblor	Type section Temblor, wi fauna like th the Ocoya C formation
		Vaqueros	

places in the Mt. Diablo Range and in the Temblor basin in general.

It was at first thought that this horizon might prove to be older than the typical Temblor, on account of the number of large pecten species it contained, but there is now quite abundant proof that a horizon older than the Temblor has not been recognized either here or in any part of Temblor basin, nor do the stratigraphic facts from any part of the basin furnish proof that older Neocene beds exist within it. It may be supposed that the occupation of the Temblor basin by the sea was transgressional and progressive, and that there are older beds belonging to the Neocene in the outer coast ranges; but if this is true, it has yet to be shown.

The relationship of Zone B both faunally and stratigraphically is clearly with the Miocene, and its correct reference to this period will hardly be questioned, notwithstanding the recent or modern aspect of some of the species, as already mentioned.

Not only is it to be regarded as Miocene, but the preponderance of evidence is undoubtedly in favor of its connection with the Lower Miocene. Any question which may arise as to its exact stratigraphic position is more likely to involve only a choice between the Temblor and the Monterey. But thus far in the study of the West Coast Miocene, the Monterey has not been regarded as the habitat of such species as *Agasoma gravidum, Turritella ocoyana, Cytherea mathewsoni, Dosinia whitneyi, Yoldia impressa,* and a score of other species given in the lists. Indeed, Dr. Merriam has cited all of the above-named species except the last as being characteristic of the beds *below* the Monterey shales. And none of the species of Zone B are characteristic of any Miocene horizon younger than the Monterey. And furthermore it must be added that while Zone B is rich in species some of which have often been found in the Monterey shales, the species most widely characteristic of the latter, namely, *Pecten peckhami,* has not been found at all in any part of the Kern River area.

In the same manner it may be shown that Zone C, both stratigraphically and faunally is related to the Temblor, rather than to any later division of the Neocene. All of its species are found in both Zones A and B, and while some of them

are found in the Santa Margarita, none of them are characteristic of it.

Since the entire stratigraphic group including Zones A, B, and C is quite conformable in position, and all its members are more closely related to the Temblor in faunal features than to any other horizon of the Neocene, it follows that if any part of the included strata is to be referred to a horizon other than the Temblor, it must be done upon the basis of criteria other than stratigraphical or paleontological. In the matter of thickness also there is little to warrant any subdivision of these beds.

The Temblor beds described in former papers devoted to the Mt. Diablo Range have in their type-locality an aggregate thickness of 1500 feet. Northward along the range the thickness diminishes until at Coalinga and on Cantua Creek it is hardly more than 300 feet.

In the San Emidio section it is not easy to say how much of the Miocene is to be classed as Temblor, but, judging from Whitney's description, it is not less than 1500 feet and may be more. The writer's estimate has been greater than this.

In the Kern River area the Lower Miocene beds, including Zones A and B, would have only an average thickness; and including all of the fossil-bearing beds the series aggregates only 1760 feet, a thickness quite comparable to that of the type-locality of the Temblor. Other localities are known in which the beds referable to the Temblor attain a much greater thickness than any here given. Elsewhere a statement has been given of the criteria upon which a provisional division of these beds might be attempted.

In the outer Coast Ranges of California are beds that have been described and classed under the undefined name of "*Vaqueros*." Without recognizing the sufficiency of this rambling and nondescript name, it may be said that most, if not all, of the strata that have hitherto been classed under this term are comparable stratigraphically and faunally to the Temblor. Dr. Arnold has described beds in the Santa Cruz mountains, and Dr. Fairbanks in the Coast mountains about San Luis Obispo that are referable to the Temblor. Dr. Merriam has pointed out that *Turritella hoffmani* is found

only in the Lower Miocene of the outer coast ranges, and has suggested that beds in which it occurs may be older than those of the interior valley in which *T. hoffmani* is replaced by *T. ocoyana*, abundant about the Kern River.

Thus far it remains to be shown that any such discrimination is warranted or possible. In other respects the Lower Miocene of the outer coast ranges does not differ faunally from the Temblor. Undoubtedly the Temblor group has its contemporaries among some of the Neocene river-deposits of the Sierra Nevada, but a correlation will not be attempted here with these deposits.

MONTEREY SHALES

It is quite impossible to recognize in the outcrop in any part of the Kern River area that member of the Miocene which forms its most characteristic feature in many parts of the Coast, that is, the Monterey Shales.

In the series as described in the preceding pages, partly from the outcrop and partly from the records of deep wells, there is one portion that bears some resemblance to the Monterey, namely, that portion which is most strongly characterized by shales, some of which are organic to a considerable extent. It will be noticed that nearly every class of materials commonly found in the Monterey has been found in the upper part of the Temblor group. Some of these points have been well brought out in Mr. Carmen's description of the formations encountered in the Grace Well No. 5, quoted above. This portion of the series embraces at least 700 to 900 feet of strata, and includes and extends from Zone C downward to or below the position of Zone B, though it cannot include more than 1160 feet.

But if this collection of strata really represents the Monterey, it is hardly comparable in thickness or character to known exposures of Monterey not far away. On the western border of the valley, at Temblor, McKittrick, Midway, and Sunset, exposures of Monterey shales, almost exclusively organic, aggregate in thickness 4000 to 5000 feet. Moreover, they overlie a considerable thickness of clearly recognized

Temblor sandstones and shales which are quite comparable to those of the Kern River. It may be added also that in the outer coast ranges the thickness of the Monterey is often as great as 3000 or 4000 feet, though this thickness may not be constant.

On the other hand, as shown in previous papers, and as admitted by others, at Coalinga and vicinity the Monterey is but very little developed, and in the Mt. Diablo Range north of Jacalitos Creek it is not clearly recognizable at all, and if actually present it is in very greatly reduced volume. Nor has it been recognized at any place on the eastern border of the Temblor basin.

It may be said, then, with reference to the Temblor, and also to the Monterey, that the conditions during the early and middle Miocene were similar in the Kern River area and in the Mt. Diablo Range in the vicinity of Coalinga. In both places on the borders of the Temblor basin the Temblor deposits are fairly well developed, while the Monterey is either absent, or is present in a reduced or disguised form. There are other facts that emphasize the absence of the Monterey on the eastern and northern borders of the basin, as will be shown later.

The explanation of this interesting fact is to be found no doubt in the diastrophic record of the times. The subsidence that inaugurated the occupation of this basin by Temblor sediments continued without interruption until middle Miocene time. It then paused, and on the eastern and northern borders of the basin the shore lines remained stationary throughout the epoch of the Monterey. In these parts, therefore, sedimentation was nil, while along the western borders, in the position of the outer coast ranges, and about the southern portion of the Mt. Diablo Range, subsidence went on without cessation, and sedimentation was therefore continuous.

It is unnecessary to suppose that there was any elevation and denudation of the older Miocene during the Monterey epoch, either in the Kern River area or elsewhere, and no such disturbance seems probable. The facts appear to indicate merely an epoch of stability along the eastern and northern shore-lines of the basin, along which, therefore, the conditions

were unfavorable for the continued accumulation of any class of sediments.

But another aspect of sedimentation may well be considered in this connection, and that is the climatic conditions of the time. The Monterey epoch appears to have been one of dry, if not arid, climate. This is shown not only by the class of detrital sediments which are characteristic of this group, but also by the organic deposits, and by the class of organisms that were dominant in this basin at the time, namely *Diatomaceae,* etc.

In the various descriptions of the Monterey deposits that have been given from time to time, it will be recalled that among the materials considered as essential in its composition are diatomaceous and other organic shales, foraminiferal limestones, volcanic ash, gypsiferous clays, and disseminated bituminous matter more or less pervading the whole group. All of these materials are not only compatible with, but are characteristic of, arid conditions of climate. Furthermore, there is a generally acknowledged absence in most places of detrital or terrigenous materials. The enormous deposits built up of remains of diatoms and of foraminifera not only indicate, but they require, undisturbed and clear water, conditions that are found only under calm and clear skies. But under arid climatic conditions there would be slight denudation of land areas, and therefore but little sedimentation of terrigenous materials along a low and stationary shore line, such as bounded the Temblor basin on the east.

The Kern River Group

The correlation of the Kern River group with any occurring in the Mt. Diablo Range cannot now be made on paleontological ground, for the reason that as far as known it is without any determinative fossils. The beds of the Kern River group, however, can be followed south to the Tejon valley, and probably can be connected toward the west with similar beds extending around the south end of the Great Valley and to the Sunset and Midway oil districts. In this way the Kern River group can, perhaps, be connected with the lower part of

the Etchegoin group occurring west of Midway; but this correlation is not given as final, but only as tentative.

In lithological character the beds of the Kern River group resemble the Santa Margarita, especially in the parts containing the heavy-boulder conglomerates, and also in the gravels, and perhaps in the greenish-colored sands; but these criteria are not conclusive.

Another and stronger feature of resemblance is in the oil-measures. It is a generally recognized fact that the oil-measures of the Sunset and Midway districts are in beds of Etchegoin age, and are principally near the bottom. The well-known occurrence of oil-measures in the Kern River group gives a means of correlation that would have great weight with many, and it may well be considered to have a strong stratigraphic if not a paleontological basis, and therefore to warrant serious consideration.

The overlapping of the Kern River group upon the older groups is similar to that of the Etchegoin as exposed elsewhere. The Kern River group, however, is in the aggregate thicker than the Etchegoin, west of Midway, but on the other hand it is thinner than the Etchegoin group north of Coalinga. It is possible that the Kern River group is contemporaneous with, and equivalent to, the upper part of the Santa Margarita and a part of the Etchegoin, and represents a transgressional or progressive subsidence of the basin-floor. This view would harmonize many points not readily determined by direct proof derived from any part of the basin.

It is less satisfactory to attempt a correlation of the Kern River group with any portion of the "McKittrick Formation" for the reason that the latter is not yet sufficiently well understood. In the published description of the McKittrick formation it is made to include both marine and fresh-water beds that are readily distinguishable, and the definition is further complicated by the use of terms that are subject to dispute. The correlation of the Kern River group with any portion of the McKittrick formation must therefore await a fuller and more consistent definition. But as both the Santa Margarita and the Etchegoin beds are known to be petroliferous about McKittrick and Midway, it is likely that the equivalents of the Kern River group will be found to include portions of both.

The Quaternary Gravels

The next collection of strata following that of the Kern River group is found in the alluvial gravels and terrace-deposits of the Kern River area. These deposits have all been formed during an epoch of subsidence, if not submergence, such as is known to have taken place generally over the whole Coast region during the late Quaternary. The horizontal position of these deposits across the truncated edges of the Kern River group, and the trenching of the latter prior to the epoch of alluviation, as shown along Caliente Creek, mark an intervening epoch of land conditions and of denudation. Quite similar facts are to be seen along the base of the Mt. Diablo Range in which the Tulare deposits are involved, which have been shown to be of Pliocene age.

An attempt was made in a former paper[1] to correlate the post-Pliocene deposits about the southern end of the Great Valley, and to suggest their relation to the terracing as well as to the previous interval of land elevation and denudation.

The interpretation here given to the Quaternary terracing and older alluvial gravel-deposits in the Kern River area, is that they represent an epoch of subsidence in late Quaternary time, following the epoch of elevation which attended glacial conditions. In other words, these features of the Quaternary period are classed with those of the Champlain epoch in general.

Economic Geology

It is not the purpose of this paper to deal specially or extensively with the economic features of the district, yet in passing a few notes may be included for the benefit of those who may desire them.

The chief economic product is, of course, petroleum, though others are at least possible in the not distant future. As far as known the petroleum deposits of commercial value are confined to the Kern River group, and therein have a stratigraphic range of 300 to 600 feet, though unproductive beds of oil-sand are found both above and below. At any one point the productive sands rarely exceed 400 feet in thickness, and they are

[1] Proc. Cal. Acad. Sci., 4th Ser., v. 3, pp. 1-40.

often confined to 250 feet or less. Mechanical difficulties often make it impracticable to draw upon all of the sands capable of yielding oil, and the perforations of the casings are sometimes extended to only half the thickness of oil strata actually encountered in drilling.

Below the base of the Kern River group and, therefore, within the Temblor, oil-sands have been reported in the records of the deep wells, but none of them are known to be capable of yielding commercial quantities of oil. The oil is generally reported to be of lighter character than that from the oil-measures of the Kern River group. Thin streaks of oil-sand and stains of oil, and shales more or less colored by bituminous matter, if not with oil, outcrop in certain localities within the Temblor. Some of these are to be seen along Kern River east of the oil-field, and in the hills north of Poso Creek as, for example, near the old fuller's-earth mine. Oil-sands are reported in some old wells a quarter of a mile north of this mine, at a depth of 1300 to 1400 feet, and gas is still issuing from one of these wells in small quantity.

Gas, which is generally regarded as an indication of oil, has been encountered in nearly all of the wells, old and new, that have been drilled into the Temblor beds. Considerable quantities of gas were found in both the Grace Well No. 5, and in the deep well of the Petroleum Development Company.

Stratigraphically, the oil is not found in a single bed extending across the field, but in sandy beds more or less separated by clays and distributed through the oil-measures. The sandy beds and clays interleave, often forming an alternating series throughout the measures. As a rule, in the developed portion of the field the sands are thicker in the eastern part of the field and become thinner toward the west, and the clays are thicker on the western border and become thin and scattered toward the east. In like manner the sands are thicker toward the south, and clays increase in volume northward.

There is considerable lack of uniformity in the well-records; but this is probably due more to faulty records than to irregularities in the beds themselves. Both sands and clay-beds are believed by some to be lenticular in section, and this is sometimes given as the cause of troubles met with in controlling the underground water. But if a lenticular condition has really

been observed in any case, it is likely to have been found along certain directions, and belongs primarily to the sands rather than to the clays, since it would owe its origin to the sorting action of currents during deposition. However, the idea of this condition comes solely from a study of the well-records, and the faulty data furnished by some of these should not be forgotten. If a well-record fails to record a particular bed of clay, it does not prove its absence, but possibly only a failure to detect it.

The structure of the beds is almost that of a simple monocline, but when studied in detail the beds undulate somewhat, forming slight anticlines and synclines striking N. W. to S. E.

The ultimate areal extent of the field has not been proved by actual developments, though the limits may be definitely known toward the northeast, if not also toward the southwest.

Thus far water has proved to be more troublesome on the southwestern border of the field; and this is partly on account of the thinner clay beds in this direction, and the greater difficulty met with in shutting it out from the wells, or in confining it to certain limits by means of these clays.

The gravity of the oil varies from 10.4° B. to 17.0°, though a large percentage of the production is between 14.5° and 16° B. Still lighter oil comes from strata below the oil measures of the Kern River group.

Water-sands, which are the source of much trouble, are found both above and below the productive beds—some within the oil-measures, though in some cases water has been let into the oil-measures by accident or by faulty drilling. It is usually possible to shut out the upper water, and when the horizon of the lower water-sands is once learned, drilling may be stopped above it. There are usually sufficient clays suitably situated for the control of the underground water if the conditions are correctly known beforehand.

The question as to the origin of petroleum is one much debated; but in California there is overwhelming evidence in favor of an organic origin, and the facts point to certain low organisms of both marine and fresh-water habitat. In the Tertiary formations of California, *Diatomaceae* are extremely abundant, and beds that are largely composed of their remains

abound in all parts of the Neocene series, excepting possibly the latest. In the Mt. Diablo Range diatomaceous and other organic shales often make up a large percentage aggregate of the Monterey and later groups, and they occur also in the Etchegoin group, included by Ralph Arnold in the so-called "McKittrick series."

The opinion has been unequivocally expressed[1] that in the Coalinga field the real source of the petroleum is in the Eocene shales underlying the Neocene, and that migration of the petroleum upward through the strata has brought it into its present repositories in the Neocene oil measures. That petroleum, in some parts of the Mt. Diablo Range and elsewhere, has originated in the Eocene cannot be denied, and it is also now found there in many places. But to conclude that all or any of the Neocene oil-measures have derived their supplies from the Eocene is illogical and unnecessary. The Neocene beds themselves contain the same organisms in even greater abundance than does the Eocene, and this is particularly true in the Mt. Diablo range. And there is no reason to suppose that the oil found in the Neocene measures has not originated in the Neocene strata themselves.

The view here expressed is that the oil found in any Neocene group has more probably originated in that group, and that migration would be far easier along the planes of bedding and lamination than at right angles to the same. That thick beds of clay and shale often restrain oil, water, and gas, is quite well demonstrated in California, and even within the Temblor basin the upward transverse migration of these substances under enormous pressure has been successfully resisted by certain impervious beds, possibly clays.

Naturally in the sedimentation of any basin the sandy detritus usually remains near shore, and the finer materials are carried away to other localities to be deposited. Also if *Diatomaceae* and other delicate organisms form any appreciable deposits they will more probably be formed off shore. In subsequent regional deformations of the strata, the organic deposits are apt to be left occupying the position of synclinal depressions, bounded by the sandy shore line deposits left lying

[1] U. S. Geol. Surv. Bull. No. 357, p. 73.

in positions inclined toward the interior of the basin. If such organic deposits give rise to any supply of petroleum or other liquid or gaseous substances, these may be forced to migrate laterally along the bedding-planes of the strata, and into the sandy strata of the border, far more readily than they could be forced upward through the clays and shales and into overlying beds.

And, if deposits of petroleum are subsequently found in sandy shore-deposits, we may expect to find not far away in the same beds the source and origin of it. Along the Kern River the conditions are all that could be required to support the view that lateral migration has been the means by which accumulation has taken place, and the same may be said of all the other producing or non-producing fields in the Temblor basin. The extent to which water, oil, and gas may migrate laterally along bedding-planes in the progress of geologic periods is, of course, very great; but the fact that it is retained at all in the rocks, even under enormous pressure, is very good proof that it cannot migrate in a vertical direction, transverse to the bedding-planes.

Thus far but little effort has been made to discover or develop water for irrigation or for other uses in the Neocene beds about the Kern River, except for field use within the Kern River district. It is worth while to note the fact, however, that water of economic value has been found in certain strata of both the Temblor and Kern River groups. In neither case has the water been found free from objectionable substances, though in each it is usable for all ordinary purposes in which relatively pure water is needed.

One of the most important attempts to develop water for economic use has been made by the Associated Oil Company in the western part of the district. On Sec. 5, T. 29 S., R. 28 E., several wells have been devoted to, or drilled for, the production of water, and these wells are supplying large volumes of water at a cost that brings it within economic limits for irrigating some kinds of crops.

None of these wells are more than 400 feet in depth, and most of the water is within 375 feet of the surface, and above the oil-measures.

Diastrophic Record

The Neocene diastrophic record in California has been more or less studied by all of the writers who have attempted the problems of correlation. Naturally there is not entire harmony in the conclusions of all, but all agree as to the main facts.

Dr. Fairbanks summarized much of the information current at the time of his writing in a paper entitled *Oscillations of the California Coast*,[1] though considerable additional information has since been developed. The conclusions as to the diastrophic record reached in the present study of the Temblor basin may be more concisely presented graphically in the accompanying diagram.

While some of the oscillations portrayed may be more or less local, they nevertheless show a tendency toward physical change that may be wide-spread, though not universal or uniform, within a given region. Furthermore, it may be stated that the oscillations here delineated do not include all that have recently been proposed by certain writers ambitious to cause a stir.

It is believed that the conclusions of this paper, however, are in harmony with those of Dr. Smith set forth in the paper before referred to and quoted. But it is not designed to carry the subject farther at the present time.

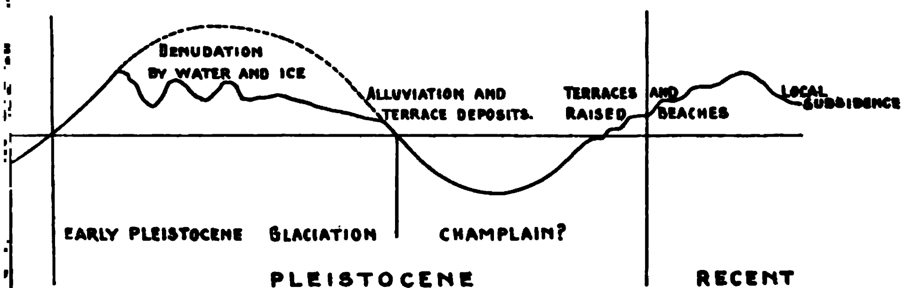
Conclusions

The more important conclusions which may be drawn from the statements of the preceding pages are briefly summarized in the following paragraphs.

The Neocene deposits of the Kern River area show a surprising lack of development when contrasted with contemporaneous deposits in the Mt. Diablo Range.

The comparatively small aggregate thickness of the series is partly explained by the fact that they do not contain all of the members of the generally accepted column of the California Neocene, or even all that have been recognized in the Mt. Diablo Range, which admittedly holds all that are most characteristic.

[1] Am. Geol., v. 20, 1897, pp. 213-245.



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The absence of the Tulare group from the Kern River area is probably due partly to its removal by erosion and partly to its being mantled over by terrace-deposits and other Quaternary gravels.

An epoch of land-conditions and therefore of elevation preceded the formation of at least some of the alluvial deposits, and it may have been during this epoch that the Tulare beds suffered most from denudation.

The fresh-water or brackish-water facies of the Temblor beds is local; and, taken in connection with the local embayment in the shore line of this epoch, affords evidence of estuarine conditions along the lower portion of the Caliente canyon, and indicates the entrance at this place of a considerable stream, derived doubtless from the contiguous portions of the Great Basin.

Logs of Deep Wells

Log of Well No. 52, Kern Trading and Oil Company, Sec. 3, T. 29 S., R. 28 E., Kern River District.

From	To	Thickness	Formation
Surface	30 feet	30 feet	Sand and clay
30 feet	58 "	28 "	Boulders
58 "	260 "	202 "	Sand and clay
260 "	290 "	30 "	Light oil-sand
290 "	300 "	10 "	Clay
300 "	330 "	30 "	Rich oil-sand
330 "	355 "	25 "	Clay
355 "	440 "	85 "	Good oil-sand
440 "	455 "	15 "	Clay
455 "	465 "	10 "	Good oil-sand
465 "	485 "	20 "	Hard sand
485 "	500 "	15 "	Good oil-sand
500 "	510 "	10 "	Clay
510 "	550 "	40 "	Good oil-sand
550 "	560 "	10 "	Clay
560 "	610 "	50 "	Good oil-sand
610 "	615 "	5 "	Clay
615 "	630 "	15 "	Oil-sand
630 "	640 "	10 "	Clay
640 "	665 "	25 "	Rich oil-sand and boulders
665 "	670 "	5 "	Clay
670 "	715 "	45 "	Oil-sand and gas
715 "	725 "	10 "	Clay
725 "	740 "	15 "	Good oil-sand
740 "	750 "	10 "	Clay
750 "	775 "	25 "	Clay
750 "	775 "	25 "	Oil-sand
775 "	789 "	14 "	Hard sand
789 "	805 "	16 "	Hard sand (4 feet below casing)

Log of Well No. 5, Grace Oil Company, Sec. 8, T. 29 S., R. 28 E., Kern River District.

The upper part of this log is similar to others in this field and is not specially interesting.

From	To	Thickness	Formation
429 feet	761 feet	232 feet	Oil-sands, etc.
761 "	1061 "	300 "	Oil-sands
1061 "	1080 "	19 "	....
1080 "	1100 "	20 "	Sandy shale
1100 "	1285 "	185 "	Sands, with water
1285 "	1305 "	20 "	Oil-sands
1305 "	1332 "	27 "	Clay and shale
1332 "	1352 "	20 "	Sandstone
1352 "	1388 "	36 "	Tough clay
1388 "	1390 "	2 "	Black shell
1390 "	1420 "	30 "	Coarse sand
1420 "	1442 "	22 "	Blue clay
1442 "	1507 "	65 "	Coarse sand (oil?)
1507 "	1535 "	28 "	Clay and sand
1535 "	1555 "	20 "	Coarse sand (oil?)
1555 "	1561 "	6 "	Blue clay
1561 "	1634 "	73 "	Sand (oil?)
1634 "	1666 "	32 "	Sand and clay
1666 "	1708 "	42 "	Sticky shale
1708 "	1715 "	7 "	Sand (asphaltum)
1715 "	1786 "	71 "	Shale, with some sand
1786 "	1798 "	12 "	Shale and sand
1798 "	1823 "	25 "	Clay shale and sand, with gas
1823 "	1835 "	12 "	Sand
1835 "	1846 "	11 "	Hard clay shale
1846 "	1871 "	25 "	Sandstone
1871 "	1875 "	4 "	Tough clay
1875 "	1921 "	46 "	Sand, with oil
1921 "	1937 "	16 "	Tough clay
1937 "	1971 "	34 "	Sand
1971 "	1998 "	27 "	Sticky clay
1998 "	2004 "	6 "	Coarse sand
2004 "	2040 "	36 "	Sandy shale
2040 "	2047 "	7 "	Sand, with oil
2047 "	2083 "	36 "	Clay shale
2083 "	2087 "	4 "	Sand, with oil and water
2087 "	2118 "	31 "	Clay shale, with shell
2118 "	2129 "	11 "	Water-sand
2129 "	2150 "	21 "	Soft shale
2150 "	2175 "	25 "	Hard shale
2175 "	2194 "	19 "	Sand (firm)
2194 "	2195 "	1 "	Sandstone
2195 "	2206 "	11 "	Dark clay shale
2206 "	2209 "	3 "	Sand, with fossils
2209 "	2217 "	8 "	Dark clay shale
2217 "	2242 "	25 "	Clay and sand alternating
2242 "	2260 "	18 "	Coarse gravel
2260 "	2591 "	331 "	Shale, with hard shells
2591 "	2701 "	110 "	Sand shale, with gas and oil
2701 "	2712 "	11 "	Sand
2712 "	2758 "	46 "	Shale

November 1, 1911.

Log of Well No. 5, Grace Oil Co.—Cont'd.

From	To	Thickness	Formation
2758 feet	2763 feet	5 feet	Hard shell
2763 "	2775 "	12 "	Sand
2775 "	2814 "	39 "	Shale, with white specks
2814 "	2837 "	23 "	Sand, with gas
2837 "	3148 "	311 "	Shale, with gas
3148 "	3166 "	18 "	Fine white sand
3166 "	....	....	Strong salt water

Log of Well No. 43, Kern Trading and Oil Company, Sec. 3, T. 29 S., R. 28 E., Kern River District.

From	To	Thickness	Formation
Surface	230 feet	230 feet	Sand and clay
230 feet	425 "	195 "	Light oil-sand—Water at 400 feet
425 "	452 "	27 "	Clay
452 "	475 "	23 "	Oil-sand and gas
475 "	485 "	10 "	Clay
485 "	530 "	45 "	Rich oil-sand
530 "	542 "	12 "	Clay
542 "	580 "	38 "	Rich oil-sand
580 "	600 "	20 "	Dry sand—Some gas
600 "	648 "	48 "	Oil-sand
648 "	650 "	2 "	Clay
650 "	690 "	40 "	Oil-sand
690 "	710 "	20 "	Clay
710 "	750 "	40 "	Oil-sand
750 "	753 "	3 "	Clay
753 "	760 "	7 "	Oil-sand
760 "	765 "	5 "	Clay
765 "	810 "	45 "	Light oil-sand
810 "	820 "	10 "	Rich oil-sand
820 "	823 "	3 "	Dry sand
823 "	830 "	7 "	Rich oil-sand
830 "	833 "	3 "	Clay
833 "	835 "	2 "	Dry sand—Bottom

Log of Well No. 31 ("Rasmussen"), Petroleum Development Company, Sec. 4, T. 29 S., R. 28 E., Kern River District.

From	To	Thickness	Formation
Surface	34 feet	34 feet	Surface formation
34 feet	85 "	51 "	Sand gravel and blue clay
85 "	262 "	177 "	Sand shale and blue clay
262 "	330 "	68 "	Oil-sand
330 "	405 "	75 "	Blue clay and hard sand
405 "	425 "	20 "	Oil-sand
425 "	450 "	25 "	Clay and sand
450 "	500 "	50 "	Oil-sand
500 "	650 "	150 "	Oil-sand and blue clay
650 "	695 "	45 "	Oil-sand
695 "	718 "	23 "	Blue clay and oil-sand

Water shut off at 255 feet.
Gas blew out top of rig at 437 feet.

Log of Well No. 51, Kern Trading and Oil Company, Sec. 3, T. 29 S., R. 28 E., Kern River District.

From	To	Thickness	Formation
Surface	30 feet	30 feet	Sand and clay
30 "	58 "	28 "	Boulders
58 "	260 "	202 "	Sand and clay
260 "	290 "	30 "	Light oil-sand
290 "	300 "	10 "	Clay
300 "	330 "	30 "	Rich oil-sand
330 "	335 "	5 "	Clay
335 "	440 "	105 "	Good oil-sand
440 "	455 "	15 "	Clay
455 "	465 "	10 "	Good oil-sand
465 "	485 "	20 "	Hard sand
485 "	500 "	15 "	Good oil-sand
500 "	510 "	10 "	Clay
510 "	550 "	40 "	Good oil-sand
550 "	560 "	10 "	Clay
560 "	610 "	50 "	Good oil-sand
610 "	615 "	5 "	Clay
615 "	630 "	15 "	Oil-sand
630 "	640 "	10 "	Clay
640 "	665 "	25 "	Rich oil-sand and boulders
665 "	670 "	5 "	Clay
670 "	715 "	45 "	Oil-sand and gas
715 "	725 "	10 "	Clay
725 "	740 "	15 "	Good oil-sand
740 "	750 "	10 "	Clay
750 "	775 "	25 "	Oil-sand
775 "	789 "	14 "	Hard sand

Log of Well No. 2, Petroleum Development Company, Sec. 24, T. 28 S., R. 27 E., Kern River District.

From	To	Thickness	Formation
Surface	460 feet	460 feet	Sand and clay
460 feet	570 "	110 "	Blue water-sand
570 "	590 "	20 "	Blue clay
590 "	610 "	20 "	Blue clay
610 "	615 "	5 "	Oil-sand
615 "	640 "	25 "	Blue clay and water-sand
640 "	1040 "	400 "	Water-sand and blue clay
1040 "	1051 "	11 "	Blue clay
1051 "	1087 "	36 "	Water-sand
1087 "	1135 "	48 "	Water-sand and clay
1135 "	1190 "	55 "	Heaving water-sand
1190 "	1435 "	245 "	Sand and clay
1435 "	1445 "	10 "	Coarse water-sand
1445 "	1465 "	20 "	Blue clay and sand
1465 "	1490 "	25 "	Water-sand
1490 "	1500 "	10 "	Hard standstone
1500 "	1725 "	225 "	Water-sand and blue clay
1725 "	1731 "	6 "	Sand, showing oil
1731 "	1790 "	59 "	Water-sand and blue clay
1790 "	1792 "	2 "	Coarse sand, showing oil and gas
1792 "	1845 "	53 "	Sand and clay, showing oil

Log of Well No. 2, Petroleum Development Co.—Cont'd.

From	To	Thickness	Formation
1845 feet	1890 feet	45 feet	Sticky blue clay
1890 "	1900 "	10 "	Blue clay, showing oil
1900 "	1930 "	30 "	Water-sand, showing oil
1930 "	2000 "	70 "	Sand and clay, showing oil
2000 "	2105 "	105 "	Sand and clay
2105 "	2130 "	25 "	Hard white sand
2130 "	2240 "	110 "	Hard brown shale
2240 "	2245 "	5 "	Fine white sand, showing some oil
2245 "	2270 "	25 "	Fine white sand

This well was abandoned.

Log of Well No. 28 ("Rasmussen"), Petroleum Development Company, Sec. 4, T. 29 S., R. 28 E., Kern River District.

From	To	Thickness	Formation
Surface	30 feet	30 feet	Sand and boulders
30 feet	285 "	255 "	Clay and sand
285 "	330 "	45 "	Blue clay and oil-sand
330 "	335 "	5 "	Oil-sand
335 "	430 "	95 "	Oil-sand and clay
430 "	470 "	40 "	Oil-sand
470 "	490 "	20 "	Oil-sand and blue clay
490 "	540 "	50 "	Blue clay
540 "	800 "	260 "	Blue clay and oil-sand
800 "	820 "	20 "	Oil-sand
820 "	905 "	85 "	Oil-sand and blue clay
905 "	1350 "	445 "	Sandy clay
1350 "	1360 "	10 "	Blue clay
1360 "	1397 "	37 "	Sandy blue clay
1397 "	1450 "	53 "	Blue clay
1450 "	1455 "	5 "	Blue clay and sand
1455 "	1461 "	6 "	White sand
1461 "	1472 "	11 "	White sand and clay
1472 "	1625 "	53 "	Sandy clay
1625 "	1652 "	27 "	Brown sandy clay
1652 "	2405 "	753 "	Brown shale
2405 "	2480 "	75 "	Sandy shale
2480 "	2566 "	86 "	Brown shale
2566 "	2580 "	14 "	Brown shale and sand
2580 "	2585 "	5 "	Sand, with fossil shells and salt water
2585 "	2612 "	27 "	Sand and brown shale
2612 "	2690 "	78 "	Hard brown shale
2690 "	2694 "	4 "	Hard sandy shale
2694 "	2805 "	111 "	Hard sand
2805 "	3000 "	195 "	Gray shale
3000 "	3050 "	50 "	Sand
3050 "	3240 "	190 "	Gray shale
3240 "	3255 "	15 "	Gray shale and brown sand
3255 "	3370 "	115 "	Blue shale
3370 "	4295 "	925 "	Gray shale
4295 "	4580 "	285 "	Brown shale
4580 "	4650 "	70 "	Sandy shale
4650 "	4660 "	10 "	Sand and some oil
4660 "	5010 "	350 "	Gray shale, etc.

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EXPLANATION OF PLATE IV

View showing defile of the Kern River, looking east at point of debouchure from the granite. The slight shoulders on each side of canyon in middle distance correspond approximately to top of lacustrine delta-terraces.

EXPLANATION OF PLATE V.

View at mouth of the Kern River defile, looking west. Old flood-plain shown on left of the river forming a wide terrace 40 feet above the present level of the stream. Granitic rocks on the extreme left.

EXPLANATION OF PLATE VI

View near mouth of the Kern River defile, looking north. Boulder-strewn flood-plain in foreground; old flood-plain terraces in middle distance strewn with river gravels; steep granite scarp in background along line of faulting.

EXPLANATION OF PLATE VII

View on the Kern River looking east. Recent flood-plain of river shown on the right and left in middle distance; older flood-plain terraces shown in background, cut into Tertiary (Neocene) formations; granitic ridge in extreme background.

EXPLANATION OF PLATE VIII

View on the Kern River looking west from point one mile below Barker's ranch. Recent flood-plain shown in foreground; Neocene hills in background showing Temblor beds near "Zone C"; abrupt change of formation noted on slopes marks the base of the Kern River group; terrace at the top 350 feet above the river.

November 1, 1911.

EXPLANATION OF PLATE IX

View on the Kern River two miles east of Oil City showing several of the older terraces; only Neocene hills visible; top of delta-terrace shown near top of ridge in the background.

EXPLANATION OF PLATE X

View on the Kern River east of oil-field, looking north; flood plain terraces; terrace gravels at top of cliff on the left.

EXPLANATION OF PLATE XI

View in the Kern River oil district, showing character of surface and other conditions.


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EXPLANATION OF PLATE XII

View in the Kern River oil district, showing characteristic scene and surface formation and topography.

EXPLANATION OF PLATE XIII

View at the mouth of the Grapevine canyon, south end of Great Valley, looking north, showing delta-terrace near 600 feet above floor of valley, and near 1500 feet above sea-level; terrace cut by recent erosion.

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NOTES ON A COLLECTION OF REPTILES FROM SOUTHERN CALIFORNIA AND ARIZONA

BY JOHN VAN DENBURGH
Curator of the Department of Herpetology

Through the kindness of my friend Dr. Charles H. Gilbert I have been afforded an opportunity to examine and report upon a collection of reptiles brought together by Mr. Dane Coolidge in 1897 and 1899. The material is chiefly of interest as an aid toward a more complete knowledge of the distribution and variation of a number of Californian species. It contains no forms new to science. The specimens, several hundred in number, were secured at various localities in San Bernardino, Riverside and San Diego counties, California, and near Yuma, Arizona. They are the property of Leland Stanford Junior University and form a part of its zoological collections.

I. LYTLE CREEK, SAN BERNARDINO COUNTY

1. **Crotaphytus collaris baileyi** (Stejneger).—Three fine male specimens, secured in May, 1899, all have two rows of interorbitals. Their femoral pores are 19-19, 17-18, and 19-19.

2. **Eumeces skiltonianus** (Baird & Girard).—One specimen, measuring 109 mm. from snout to vent, was taken in May, 1899. It is entirely without stripes.

January 15, 1912

II. SWARTONT CAÑON, SAN BERNARDINO COUNTY

1. **Uta stansburiana** Baird & Girard.—One typical specimen taken July 29, 1899.

2. **Sceloporus biseriatus** Hallowell.—Several. July 29, 1899.

3 **Phrynosoma blainvillii** Gray.—Three specimens, caught July 29, 1899, are nearly intermediate between this species and *P. frontale* as regards the character of their head-plates. It therefore becomes necessary to regard the northern flat-scaled form as a subspecies of *P. blainvillii* under the name *Phrynosoma blainvillii frontale.* The characters which distinguish these two forms are remarkably constant in specimens from northern Lower California, San Diego County, and Riverside County on the one hand, and the territory North of 35° on the other.

Mr. Coolidge notes that the largest specimen of the three, a female, squirted blood three times from its eyes when captured.

4. **Gerrhonotus scincicauda ignavus** Van Denburgh.—The only specimen is so young that it does not show the characters of this subspecies very distinctly, but can be identified by the character of the keeling of its caudal scales. It was taken July 29, 1899.

III. VICTOR, SAN BERNARDINO COUNTY

1. **Sceloporus magister** Hallowell.—One male and one female typical of this species were obtained in May, 1897. The former has twelve femoral pores.

IV. CAJON PASS, SAN BERNARDINO COUNTY

1. **Callisaurus ventralis** (Hallowell).—A single lizard of this species was found July 25, 1899.

2. **Uta stansburiana** Baird & Girard.—Two typical examples were taken July 25, 1899.

3. **Sceloporus biseriatus** Hallowell.—This fence-lizard is represented in the collection by a single specimen taken July 25, 1899.

4. **Phrynosoma blainvillii** Gray.—Ten adult and several young specimens were secured in July, 1897. Two have head-

plates nearly as rough as in *P. b. frontale,* but in both specimens these plates are convex as in *P. blainvillii.* Another has these plates nearly flat but almost smooth. The other specimens are typical *P. blainvillii.*

V. GRAPELAND, SAN BERNARDINO COUNTY

1. **Sceloporus biseriatus** Hallowell.—This was the only species collected in this locality.

VI. WATERMAN'S CAÑON, SAN BERNARDINO MTS., SAN BERNARDINO COUNTY.

1. **Uta stansburiana** Baird & Girard.—Secured in June, 1899.
2. **Sceloporus biseriatus** Hallowell.—A large series was taken in June, 1899. No male shows two blue throat-spots.
3. **Sceloporus orcutti** Stejneger.
4. **Lampropeltis californiæ** (Blainville).—This snake is represented by a single specimen.

VII. BLUFF LAKE, SAN BERNARDINO MTS., SAN BERNARDINO COUNTY

1. **Uta stansburiana** Baird & Girard.
2. **Sceloporus graciosus** Baird & Girard.
3. **Eumeces skiltonianus** (Baird & Girard).—A young specimen was caught in June, 1899.
4. **Pituophis catenifer** (Blainville).— One gopher-snake was captured June 23, 1899. Its gastrosteges are 222 and its urosteges 77.
5. **Thamnophis hammondii** (Kennicott).—Mr. Coolidge secured a single snake typical of this species July 2, 1899. Gastrosteges 165. Scale rows 21.
6. **Crotalus oregonus** Holbrook.

VIII. RIVERSIDE, RIVERSIDE COUNTY

1. **Hyla regilla** Baird & Girard.
2. **Rana draytonii** Baird & Girard.

3. **Uta stansburiana** Baird & Girard.

4. **Sceloporus biseriatus** Hallowell.

5. **Sceloporus orcutti** Stejneger.

6. **Phrynosoma blainvillii** Gray.

7. **Lampropeltis boylii** Baird & Girard.

8. **Salvadora grahamiæ** Baird & Girard.—A *Salvadora* taken here by Mr. Coolidge has 17 scale rows, gastrosteges 199, urosteges 92, frontal short and broad, parietal short, rostral wide with detached edges, first pair of infralabials elongated posteriorly, mental small, and posterior genials separated by small scales. I have no specimen from Texas for comparison. Ten from Lower California agree in the main with this one from Riverside but have rather larger rostrals and show that the shape of the frontal and parietal plates is inconstant.

9. **Arizona elegans** Kennicott.—One specimen.

10. **Pituophis catenifer** (Blainville).—One young gopher-snake, taken July 3, 1899, has four large and two small prefrontals, 68 urosteges, and scales in 33 rows.

11. **Thamnophis parietalis** (Say).—Typical.

12. **Thamnophis hammondii** (Kennicott).—One young garter-snake was secured August 7, 1899.

IX. Temescal Mts., Riverside County

1. **Uta stansburiana** Baird & Girard.—Two typical males were obtained July 12, 1899.

2. **Sceloporus orcutti** Stejneger.—A large male taken July 10, 1899, is typical of this species. The tail has been reproduced and is forked.

3. **Phrynosoma blainvillii** Gray.—Five typical adult females were collected July 12, 1899.

4. **Gerrhonotus scincicauda ignavus** Van Denburgh.—A single specimen is evidently of this form.

5. **Cnemidophorus stejnegeri** Van Denburgh.—Five whip-tailed lizards were secured July 10, 1899. The younger specimens have the markings on the throat smaller and less numerous than in adults.

6. **Verticaria hyperythra beldingi** Stejneger.—Mr. Coolidge captured one specimen of this lizard July 10, 1899.

X. Gavillan, Riverside County

1. **Sceloporus biseriatus** Hallowell.—This species was collected August 9, 1899.

2. **Sceloporus orcutti** Stejneger.—Five typical examples were taken in August, 1899.

3. **Lichanura roseofusca** Cope.—The only snake of this species in the collection was caught by Elmer Schellinger in May, 1899. It has 237 gastrosteges and scales in 41 rows. The rostral is prominent and there are three true loreals.

XI. Perris Valley, Riverside County

1. **Sceloporus orcutti** Stejneger.—Many typical specimens were secured in July, 1897.

2. **Phrynosoma blainvillii** Gray.—The head-plates are typical of this form in six horned-toads obtained in Perris Valley, July 26, 1897.

XII. Chihuahua Mts., San Diego County

1. **Uta stansburiana** Baird & Girard.—Typical specimens were collected July 30-31, 1897.

2. **Sceloporus biseriatus** Hallowell.—Twenty-one lizards of this species, representing various ages and both sexes, are all typical as regards the single blue throat-patch and the separation of the supraoculars from the median head-plates.

3. **Sceloporus orcutti** Stejneger.—Five were taken July 30-31, 1897.

4. **Cnemidophorus stejnegeri** Van Denburgh.—This species is represented by a single specimen.

5. **Eumeces skiltonianus** Baird & Girard.—One young skink was secured in July, 1897.

XIII. Cuyamaca, San Diego County

1. **Uta stansburiana** Baird & Girard.
2. **Sceloporus biseriatus**' Hallowell.
3. **Cnemidophorus stejnegeri** Van Denburgh.
4. **Lampropeltis californiæ** (Blainville).
5. **Thamnophis hammondii** (Kennicott).
6. **Crotalus oregonus** Holbrook.

XIV. Oak Grove, San Diego County

1. **Callisaurus ventralis** Hallowell.—Ten were taken near Oak Grove in July.

2. **Crotaphytus wislizenii** Baird & Girard.—A leopard lizard was obtained in July, 1897.

3. **Uta stansburiana** Baird & Girard.

4. **Sceloporus biseriatus** Hallowell.—This species was collected in July, 1897.

5. **Sceloporus orcutti** Stejneger.

6. **Phrynosoma blainvillii** Gray.—Three young horned-toads are labeled Oak Grove.

7. **Verticaria hyperythra beldingi** Stejneger.—Two typical examples of Belding's Orange-throat were secured in July, 1897.

8. **Thamnophis hammondii** (Kennicott).—This very distinct species is represented from this locality by one young and one adult specimen taken in July, 1897.

XV. Coyote Cañon, Colorado Desert, San Diego County

1. **Crotalus mitchellii** Cope.—One rattlesnake typical of this species was secured in Coyote Cañon. It appears to differ in no way from specimens from the Cape Region of Lower California.

XVI. Fort Yuma, Imperial County

1. **Crotaphytus wislizenii** Baird & Girard.—This lizard was found at Hall Hanlon's Ranch June 2, 1899.

2. **Uta stansburiana** Baird & Girard.—Brown-shouldered lizards were taken at Hanlon's, May 28, 1899.

XVII. Yuma, Arizona

1. **Coleonyx variegatus** Baird.—One male with six preanal pores.

2. **Dipsosaurus dorsalis** Baird & Girard.—28 specimens of this lizard are in the collection. Of these, 25 have nasals of both sides separated from the rostral by two rows of scales, while in three cases, on one side of the head but a single row intervenes.

3. **Uma notata** Baird.—Seventeen specimens were taken near Yuma in May and June, 1899. The keeled suborbitals vary in number from three to six; the loreal rows from four to seven; supraocular rows from eight to ten; supralabials from eight to ten; infralabials from eleven to seventeen; and femoral pores from twenty-two to thirty.

4. **Callisaurus ventralis** (Hallowell).—Mr. Coolidge preserved fifty-two specimens of this lizard. Only one of these has three lateral black blotches, the number found in *C. dracontoides*. In this specimen, as in all others, these blotches are very oblique.

5. **Crotaphytus wislizenii** Baird & Girard.—Two leopard lizards were taken in May and June, 1899.

6. **Uta stansburiana** Baird & Girard.—This species is common at Yuma, where a number were collected.

7. **Uta symmetrica** Baird.—Numerous specimens of this species were collected in May, 1899.

8. **Sceloporus magister** Hallowell.—The number of femoral pores in the fifteen specimens secured ranges from eight to fifteen, the average of the thirty series being 12.1.

9. **Phrynosoma m'callii** (Hallowell).—One fine horned-toad of this species was caught June 9, 1899. It has seventeen femoral pores.

10. **Cnemidophorus tigris** Baird & Girard.—One specimen has the frontoparietal plates united for the anterior third of their length. None has enlarged postantebrachials, and in none is the second labial in contact with the anterior nasal. In all these specimens the enlarged preanals are two, preceded by one, which in turn is usually preceded by one. Femoral pores in 40 specimens vary from 15 to 25; the average of 80 thighs is 20.4 (average of 40 right legs 20.41, of 40 left legs 20.42). All the specimens are very dark. The gular regions, and the lower surface of the body nearly to the insertion of the hind limbs, are dark slate or black, usually with light markings along the posterior edges of the ventral plates.

11. **Siagonodon humilis** (Baird & Girard).—One typical specimen was taken May 22, 1899.

12. **Chionactis episcopus** (Kennicott).—This *Chionactis* has a light vinaceous-rufous band extending along the back from the occiput to the tip of the tail. This band is four or

five scales wide on the body, and two or three on the tail. The central two or three rows show only very faint darker markings, but the scales of the more lateral rows are marked each with a central dash of dark hair-brown, while their margins are whitish. The dark dashes therefore appear as a brown line along the middle of each row of scales, with the exception of a few of the dorsal rows, while the ground color is reddish dorsally and white laterally. The head is pale yellowish brown with a large dark brown blotch on the parietal and frontal plates. This specimen has scales in 15 rows, gastrosteges 169, urosteges 45, postgenials very small, supralabials 6-7, infralabials 6-6. It measures: length to anus 270 mm., length of tail 59 mm. In a second specimen the reddish dorsal band is rendered less distinct by the presence on the dorsal scales of central dark markings similar to those of the lateral scales. The scales are 15 rows, gastrosteges 168, urosteges 47, postgenials very small, supralabials 7-7, infralabials 6-6.

'13. **Rhinocheilus lecontei** Baird & Girard.—A single snake of this species was secured May 23, 1899. Its labials are $\frac{8\text{-}8}{9\text{-}9}$; scale rows 25; gastrosteges 206; urosteges forty single, followed by eight pairs.

14. **Lampropeltis conjuncta** (Cope)?— One milk-snake, caught June 5, 1899, is very similar in coloration to specimens from the Cape Region of Lower California. It has 23 rows of scales, 237 gastrosteges, and 57 urosteges.

15. **Bascanion flagellum frenatum** Stejneger.—One specimen taken May 21, 1899, has scales in 17 rows, gastrosteges 193, urosteges 100.

16. **Thamnophis marcianus** (Baird & Girard.—I refer to this name two garter-snakes captured at Yuma. The larger measures 375 mm. to anus, tail 94 mm. These specimens agree in having the lateral stripe on the third or the second and third rows, nuchal blotches and labial markings very distinct, one row of scales smooth, postgenials much longer than anterior, and gastrosteges 159. In one specimen the scales are in 21 rows, temporals 1-3, supralabials 8-8, and urosteges 65. In the other the scales vary in number from 21 to 26 rows, temporals 1-2, supralabials 7-8, and urosteges 54 (tip missing).

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NOTES ON SOME REPTILES AND AMPHIBIANS FROM OREGON, IDAHO AND UTAH

BY JOHN VAN DENBURGH
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The following notes are based upon material secured in 1894, by Dr. Charles H. Gilbert, of Leland Stanford Junior University. While the number of species is not large, the data on distribution are of considerable interest to the student of zoögeography, for the herpetology of Idaho is but little known. I am indebted to Dr. Gilbert for the privilege of reporting upon the collection.

1. **Clemmys marmorata** (B. & G.).—A single specimen of this turtle was taken at Klamath Falls, Oregon, June 16, 1894.

2. **Crotaphytus wislizenii** B. & G.—Twenty-seven adult specimens of this fine lizard agree perfectly, both in dimensions and coloration, with this form as distinguished from *Crotaphytus silus* Stejneger of the San Joaquin Valley, California. Three very young specimens, however, have dimensions and coloration very nearly as in *C. silus;* but that form is not based upon immature individuals. The dorsal markings, both lines and spots, have a tendency to disappear in old individuals. Usually the lines fade first, leaving the spots fairly distinct; but the reverse order of disappearance may occur. Thus is formed a great series of color-patterns.

These specimens were all collected in Idaho:—at Weiser, Washington County, Aug. 6, 1894; plains of Snake River, by Upper Salmon Falls, Aug. 9, 1894; plains on south side of

January 15, 1912

Snake River, Salmon Falls, Aug. 9, 1894; between Blue Lake and Shoshone Falls (on upland), Aug. 13, 1894; plains between Bliss and Snake River, Aug. 10, 1894; plains north of Snake River, between Upper Salmon Falls and Bliss, Aug. 10, 1894; plains across river from Glen's Ferry, Aug. 8, 1894; Snake River shore at Upper Salmon Falls, Aug. 10, 1894; near Cottonwood Creek, Cassia Co., Aug. 23, 1894; and Glen's Ferry, Aug. 8, 1894.

3. **Uta stansburiana** B. & G.—This wide ranging species was found, in Idaho, between Blue Lakes and Shoshone Falls, Aug. 13, 1894; on the plains between Bliss and Snake River, Aug. 10, 1894; sage-brush plains between Shoshone and Blue Lakes, Logan County, Aug. 12, 1894; south side of the cañon between Shoshone Falls and Twin Falls, Snake River, Aug. 15, 1894.

4. **Sceloporus occidentalis** B. & G.—A single specimen of this lizard was obtained near Cottage Grove, Lane County, Oregon, June 27, 1894.

5. **Sceloporus biseriatus** Hallowell.—I have been unable to detect any difference between specimens of this lizard from southern California and the sixteen which were collected in Idaho, at Blue Lakes Cañon, Aug. 13, 1894; on sage-brush plains between Shoshone and Blue Lakes, Aug. 12, 1894; on the cañon walls at Shoshone Falls north of ferry, and at Blue Lakes, Aug. 16, 1894; and between Blue Lakes and Shoshone Falls, Aug. 13, 1894.

6. **Sceloporus graciosus** B. & G.—The numerous specimens from Idaho fall well within the known variation of this species, both as regards coloration and scale characters. They were collected on the plains between Bliss and Snake River, Aug. 10, 1894; plains across river from Glen's Ferry, Aug. 8, 1894; sage-plains near Conant, Raft River, Cassia Co., Aug. 21, 1894; sage-plains between Shoshone and Blue Lakes, Aug. 12, 1894; Blue Lakes Cañon, Logan Co., Aug. 13, 1894; and at Weiser, Washington Co., Aug.. 6, 1894. The species was found also at Kelso, Cowlitz County, Washington, March 23, 1894.

7. **Phrynosoma douglassii** (Bell).—A very noticeable difference in color between this and the following species is the indistinctness, in *P. douglassii,* of the dark nuchal blotches, which are so clear and well-defined in *P. platyrhinos.* In

adults, this difference is somewhat less marked, for while the colors of *P. douglassii* seem to become more intense with age, those of *P. platyrhinos* seem to fade. The largest specimens are 84, 87, and 90 mm. long; the smallest, 33 mm.

These specimens were secured on the sage-brush plains near Conant, Cassia County, Aug. 21, 1894; near Cottonwood Creek, Cassia County, Aug. 23, 1894; at Arco, Alturas County, Aug. 23, 1894; and at American Falls, Snake River, Aug. 25, 1894. It has also been secured at Grant's, Oregon, by Mr. Gilbert Edgington.

8. **Phrynosoma platyrhinos** Girard.—Numerous specimens of this horned-toad were secured on the plains across the river from Glen's Ferry, Aug. 8, 1894; on the plains between Bliss and Snake River, Aug. 10, 1894; sage-plains between Shoshone and Blue Lakes, Logan County, Aug. 12, 1894; on sage-plain near Blue Lakes, Logan County, Aug. 16, 1894; and near Cottonwood Creek, Cassia County, Idaho, Aug. 23, 1894.

In one of these specimens there is no trace of an enlarged series of gular scales. The majority have these series represented, on one or both sides, by a few scales slightly larger than those around them. One specimen has the series fairly well developed. The same differences exist in specimens from Arizona and southern California. Two specimens have naked tympana, but in the others the tympana are fully scaled. The number of femoral pores ranges from eight to twelve.

9. **Gerrhonotus scincicauda** (Skilton).—A single specimen, secured at Drain, Douglas County, Oregon, June 26, 1894, is unquestionably referable to this species.

10. **Cnemidophorus tigris** B. & G.—This lizard is represented in the collection by nine typical specimens, only one of which has the throat and chest strongly tinged with black. The dorsal color-pattern is not more distinct in young than in adults. These specimens were secured at Glen's Ferry, Aug. 8, 1894; Blue Lakes Cañon, Logan County, Aug. 13, 1894; south side of the cañon between Shoshone Falls and Twin Falls, Snake River, Aug. 15, 1894; on sage-plain near Blue Lakes, Logan County, Aug. 16, 1894; Snake River plains by Upper Salmon Falls, Aug. 9, 1894.

11. **Bascanion tæniatum** Hallowell.—A fine specimen of this racer was obtained on the plains between Snake River and

Bliss, Aug. 10, 1894. The lower surfaces are beautifully tinted posteriorly with rose pink.

12. **Pituophis catenifer** (Blainv.).—The Western Gopher-Snake was collected at Roseburg, Oregon, and at Blue Lake, Idaho. I can detect no difference from California specimens.

13. **Thamnophis parietalis** (Say).—A garter-snake of this species was taken at Weiser, Idaho, August 6, and another near Bear River, Logan County, Utah, August 27, 1894.

14. **Thamnophis vagrans** (B. & G.).—The Wandering Garter-Snake was collected in Oregon at Umatilla and Wallowa; in Idaho at Arco, Shoshone Falls, Warderer, Ketcham, Weiser, on the plains along the south side of the Snake River near Salmon Falls, at the head of Malade River Cañon, on Cottonwood Creek, Cassia County, near Clear Water River seven miles above Lewiston, Nez Perces County, and near Potlatch Creek two miles above Lewiston; and in Utah near Bear River, Logan County.

15. **Thamnophis vagrans biscutata** (Cope).—Four specimens of this snake were preserved at Klamath Falls, Oregon, where thousands were observed. They differ in coloration from most of the specimens from Washington which I have referred to this subspecies, showing fewer spots, and somewhat resemble certain specimens of *T. elegans*. Some of their scale characters are: nasals, 2-2, 2-2, 2-2, 2-2; loreal, 1-1, 1-1, 1-1, 1-1; preoculars, 1-1, 2-2, 2-2, 3-3; postoculars, 3-3, 3-3, 3-3, 3-3; temporals, 1+3—1+3, 1+2—1+2, 1+3—1+3, 1+2—1+2; genials, posterior much longer, posterior much longer, equal, equal; supralabials, 8-8, 8-8, 8-8, 8-8; scale rows, 23, 23, 21, 21; urosteges, 76, —, 73, —; gastrosteges, 168, —, 165, —.

16. **Crotalus oregonus** Holbrook.—The Pacific Rattlesnake was secured at Klamath Falls, Oregon; and at Twin Falls, and in Blue Lakes Cañon, Idaho.

17. **Rana pipiens brachycephala** (Cope).—This beautiful frog was caught in the Snake River at American Falls, Oneida County; at Montgomery's Ferry, at the mouth of the Weiser River, Weiser, Washington County; at Spring Branch, just above Shoshone Falls, Logan County; and at Blue Lake Spring, Idaho. It was also taken at Logan, Cache County, Utah.

18. **Rana aurora** B. & G.—The collection contains specimens of *Rana aurora* from Eugene, Lane County; and Clear Creek, near Oregon City, Clackamas County, Oregon.

19. **Rana pretiosa** B. & G.—This frog was found at Island City, and in Grand Ronde River, Union County, Oregon.

20. **Rana boylii** Baird.—Among the most interesting specimens in the collection are four specimens of Boyle's Frog caught in Deer Creek, near Roseburg; and in the Umpqua River, Douglass County, Oregon. They seem identical with Californian specimens.

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GEOLOGIC RANGE OF MIOCENE INVERTEBRATE FOSSILS OF CALIFORNIA

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April 2, 1912

Faunal Zones in the Miocene of California.

When Conrad described the Tertiary fossils of California in the Reports of the Pacific Railroad Survey, he assigned some species to the Miocene on account of a vague resemblance to Miocene species from Virginia and Maryland; but he had no positive criterion for distinguishing the various faunas. When, in 1868, Gabb wrote his monograph on the Tertiary of California, he, too, had little opportunity of distinguishing the separate faunas that make up the beautiful succession, as we know it, on the West Coast. Where the rock beds were much disturbed and hardened, he called them Miocene; and where they were little disturbed, and not lithified to any extent, he called them Pliocene. This criterion was usually right, but not always; for there are Miocene beds in California that are unconsolidated, and Pliocene beds that are turned up on edge and hardened into real rocks. In fact, the principal disturbance in the Tertiary beds of the Coast Ranges came in the mountain-making epoch at the end of Monterey, in the middle Miocene time, and, after this, several thousand feet of sandstones were laid down still containing Miocene fossils in abundance.

Later writers—Fairbanks, F. M. Anderson, Merriam, Lawson, and Arnold—have introduced a much more elaborate classification of the Neocene of California, and a large number of formation-names. But these so-called formations, however useful they may be for areal mapping and for economic geology, do not always correspond to the faunal divisions. Some of them are merely different facies of the same thing. The formations have been subdivided much more minutely than the faunas warrant.

Instead of the numerous subdivisions recognized by most stratigraphers, there are, in fact, only two major faunal units in the Miocene of California: a lower, including all the faunas up through the Monterey; and an upper, including the San Pablo, Santa Margarita, and Etchegoin faunas. The division line between them corresponds to the period of orogenic activity that came on at the end of the Monterey epoch. This marks not only a great change in the physiography of the West

Coast, but also the extinction of many of the older Miocene types, and the introduction of new forms, many of which have survived until the present time. This brings us back almost to the standpoint of Lawson and Merriam, who have proposed to call all the lower Miocene "Monterey," and all the upper Miocene "San Pablo."

The beds containing the Vaqueros, Temblor, and Monterey faunas were uplifted and somewhat hardened in the Coast Range uplift; and on the eroded flanks of this range were laid down the younger Miocene strata containing the Santa Margarita, San Pablo, and Etchegoin faunas. They too have been upturned by later disturbances, but not hardened to such a degree as were the older beds.

The fossils in these later Miocene beds not only have a much more recent appearance than those of the lower Miocene, but also the number of species still living is much greater among them. The number of these living species increases gradually as the top of the Miocene is approached, and the faunas grade over imperceptibly into the Pliocene. There is no natural boundary between Miocene and Pliocene in California, and the line is drawn between the Etchegoin and Purisima as a matter of convenience. In fact the two faunas overlap; and the formations may well do so. The Etchegoin has been called the Pliocene by F. M. Anderson, and upper Miocene by Arnold. The overlying Purisima has been called transitional by Ashley, Pliocene by Arnold, and upper Miocene by Dall. And since all these writers had good reasons for their opinions, it is safe to conclude that the line between Miocene and Pliocene should be drawn somewhere near the boundary line between the two formations.

One of the most striking characteristics of the Tertiary of California is the orderly advance toward modern life, with a constantly increasing number of modern species, and a constantly increasing number of species closely allied to recent forms. Step by step each succeeding fauna becomes more like the present life of the California coast than the preceding. This gradual change finds its explanation in the physiography of the region. All through the Tertiary the coast line of California was nearly the same as at present; for while the orogenic

disturbances during that age have been profound and far-reaching, they were longitudinal. There was here, as elsewhere in the northern hemisphere, a gradual drop from the subtropical warmth of the Eocene to the cool climate of the Pliocene, the chill of the Glacial Epoch, and then a fluctuating rise to the genial climate of the present. This has been recorded in the successive marine faunas, but the changes were so gradual that during the Neocene there was no catastrophic destruction of the inhabitants of the sea. From each geologic formation many species live on into the next. It would have delighted Lyell to see such a complete illustration of the principle he adopted for the subdivision of the Tertiary, for here we have a gradation from the Eocene with no living species, through the Miocene and Pliocene with gradually increasing number of modern forms, the Quaternary with about 90 per cent of recent species, to the present, where in the same region, out of a marine fauna of somewhere near a thousand species, over four hundred extend back into the Quaternary, and nearly a hundred extend back into the Tertiary.

TABLE OF MIOCENE FAUNAS OF CALIFORNIA.

MIOCENE	UPPER	ETCHEGOIN fauna, of the Coalinga region, of the Salinas and the San Benito valleys.
		SAN PABLO-SANTA MARGARITA faunas, of the Mt. Diablo region, Salinas valley, and the Coalinga region.
	LOWER	MONTEREY-TEMBLOR faunas, of the Contra Costa hills, Mt. Hamilton Range, Black Mountain, Santa Lucia Range, Coalinga region, Bakersfield region, Santa Ynez and Santa Monica mountains, and Santa Ana Range.
		VAQUEROS fauna, of the Santa Lucia Range, Black Mountain, the Santa Monica and Santa Ynez mountains.

As shown in the table, there are only two major faunal divisions of the Miocene: a lower, including the Vaqueros and the Monterey-Temblor faunas; and an upper, including the San Pablo-Santa Margarita and the Etchegoin faunas.

The entire Miocene fauna consists of about 300 species described, and of these about 220 are confined to the Miocene.

The entire lower Miocene, as known as present, consists of about 173 species, of which 116 are confined to lower Miocene, 25 range into upper Miocene; 11 range into Pliocene; 1 ranges

into Quaternary; and 20 persist into the Recent fauna. The percentage of Recent species in the lower Miocene fauna taken as a whole is 11 per cent.

The Vaqueros fauna consists of 56 species, of which 10 are confined to the Vaqueros, or to this and the San Lorenzo Oligocene faunas; 25 range into the Monterey-Temblor faunas; 10 range into upper Miocene; 3 into Pliocene; 1 into Quaternary; and 6 range into the Recent fauna, giving 10 per cent of living species.

The Monterey-Temblor faunas contain a total of about 154 species, of which 25 range up from Vaqueros; about 70 are confined to Monterey-Temblor; 26 range into upper Miocene; 11 into Pliocene; 1 ranges into Quaternary; and 20 persist into the Recent fauna, giving 13 per cent of Recent species.

The following characteristic species are confined to the Vaqueros fauna:

Modiolus inezanus Arnold
Pecten magnolia Conrad
Pecten vanvlecki Arnold
Pecten vaughani Arnold
Turritella inezana Conrad
Turritella inezana var. *sespeensis* Arnold
Purpura vaquerosensis Arnold
Natica inezana Conrad
Scutella fairbanksi Arnold
Terebratalia kennedyi Arnold

This lowest horizon of the Miocene has been called by Merriam[1] the zone of *Turritella hoffmanni* (=*Turritella inezana*); it may eventually be found to be the inshore equivalent of the deep-water San Lorenzo Oligocene, with which it has a few species in common. Of this fauna only six species are known to have persisted to the present, namely, *Terebratalia occidentalis, Balanus concavus, Hinnites giganteus, Macoma nasuta, Phacoides richthofeni,* and *Psammobia edentula;* and of these *Macoma nasuta* appeared in the San Lorenzo Oligocene.

The following characteristic species are confined to the Vaqueros and Monterey-Temblor faunas:

Arca montereyana Osmont
Cardium vaquerosense Arnold
Chione conradiana Anderson
Chione mathewsoni Gabb
Dosinia conradi Gabb
Dosinia mathewsoni Gabb
Glycimeris branneri Arnold
Pecten branneri Arnold
Pecten lompocensis Arnold
Pecten miguelensis Arnold
Pecten nevadanus Conrad
Pecten peckhami Gabb
Pecten perrini Arnold
Pecten sanctaecruzensis Arnold
Pecten sespeensis Arnold
Agasoma barkerianum Cooper
Agasoma gravidum Gabb
Cuma biplicata Gabb
Trochita costellata Gabb

[1] Bull. Dept. Geol. Univ. Calif., vol. 3 (1904), p. 380.

The following characteristic species are confined to the Monterey-Temblor fauna:

Scutella breweriana Remond
Scutella merriami Anderson
Corbicula dumblei Anderson
Glycimeris barbarensis Conrad
Pecten hamlini Arnold
Pecten propatulus Conrad
Tellina congesta Conrad
Yoldia impressa Conrad
Yoldia oregona Shumard
Agasoma santacruzanum Arnold
Bathytoma keepi Arnold
Bullia anglonana Anderson
Cancellaria condoni Anderson
Conus hayesi Arnold
Conus owenianus Anderson
Ficus kernianus Cooper
Ficus nodiferus Gabb
Ficus pyriformis Gabb
Ficus stanfordensis Arnold
Oliva californica Anderson
Terebra cooperi Anderson
Trophon gabbianus Anderson
Turritella ocoyana Conrad
Turritella variata Conrad

In addition to the six species enumerated under the Vaqueros, the following species persist from the Monterey-Temblor fauna into the present:

Cardium quadrigenarium Conrad
Dosinia ponderosa Gabb
Leda taphria Dall
Macoma calcarea Gmelin
Macoma secta Conrad
Mactra catilliformis Conrad
Metis alta Conrad
Panopaea generosa Gould
Phacoides annulatus Reeve
Saxidomus nuttalli Conrad
Solen sicarius Gould
Tellina idae Dall
Lunatia lewisii Gould
Olivella pedroana Conrad

The entire upper Miocene fauna consists of about 182 species known at present. Of these 26 range up from lower Miocene, and become extinct in the San Pablo-Santa Margarita and Etchegoin faunas; about 77 are confined to the upper Miocene; 26 range into Pliocene, and become extinct in the Purisima or San Diego horizon; 2 range into Quaternary; and 50 persist into the Recent fauna.

The lower division of the upper Miocene consists of the San Pablo-Santa Margarita-Jacalitos faunas, which are a unit, or nearly so—the Jacalitos being merely the upper division of the Santa Margarita, and both together being the approximate equivalent of San Pablo. The aggregate fauna of this division amounts to 117 species, of which 38 are still living, giving 32 per cent of Recent forms.

In the Etchegoin fauna there are known 111 species, with 20 additional that existed both before and after that time, making 131 species. Of these 51 are still living, giving 38 per cent of Recent species in the Etchegoin fauna.

The following common and characteristic species range up from the lower Miocene, and become extinct in the San Pablo-Santa Margarita fauna:

Arca microdonta Conrad
Arca obispoana Conrad
Chione temblorensis Anderson
Cytherea diabloensis Anderson
Modiolus multiradiatus Gabb
Ostrea titan Conrad
Panopaea estrellana Conrad
Pecten andersoni Arnold
Pecten crassicardo Conrad
Pecten discus Conrad
Pecten estrellanus Conrad
Trophon carisaensis Anderson

The following characteristic species are confined to the San Pablo-Etchegoin fauna:

Pecten pabloensis Conrad
Astrodapsis antiselli Conrad
Astrodapsis tumidus Remond
Astrodapsis whitneyi Remond
Tamiosoma gregaria Conrad

The following species lived over from the lower Miocene, and became extinct in the Etchegoin:

Mulinia densata Conrad
Sigaretus scopulosus Conrad
Zirphea dentata Conrad
Trophon ponderosus Gabb

The following characteristic upper Miocene species became extinct in the Etchegoin:

Diplodonta harfordi Anderson
Diplodonta parilis Conrad
Glycimeris coalingaensis Arnold
Modiolus directus Dall
Mytilus coalingaensis Arnold
Ostrea vespertina Conrad
Ostrea atwoodi Gabb
Pecten coalingaensis Arnold
Placuanomia californica Arnold
Thais kettlemanensis Arnold
Turritella vanvlecki Arnold

The following characteristic species range up from lower Miocene, and become extinct in the lower Pliocene, Purisima-San Diego fauna:

Scutella gibbsi Gabb
Arca trilineata Conrad
Chione securis Shumard
Trochita filosa Gabb
Mactra albaria Conrad
Marcia oregonensis Conrad
Phacoides sanctaecrucis Arnold
Thracia trapezoidea Conrad
Venus pertenuis Gabb
Chione staleyi Gabb
Trochita inornata Gabb

The following characteristic upper Miocene species range over into lower Pliocene, and become extinct in the Purisima-San Diego fauna:

Astrodapsis perrini Weaver
Scutella gibbsi Gabb var. *ashleyi* Arnold
Arca canalis Conrad
Cryptomya ovalis Conrad
Cardium coosense Dall
Cardium meekanum Gabb
Macoma astori Dall
Ostrea veatchi Gabb
Pecten cerrosensis Gabb
Pecten cerrosensis var. *mendenhalli* Arnold
Pecten nutteri Arnold
Pecten oweni Arnold
Pecten wattsi Arnold
Schizothoerus pajaroanus Conrad
Chrysodomus imperialis Dall
Chrysodomus portolaensis Arnold
Miopleioma oregonensis Dall

Crepidula princeps Conrad persists from lower Miocene into Quaternary, and *Pisania fortis* Carpenter persists from upper Miocene into Quaternary before becoming extinct.

Throughout the Miocene, into the Pliocene, and up to the present, little evolution of forms is seen. Species appear with all their characteristics distinctly marked, run their course, and disappear from our ken, without any appreciable change. The geologist, looking over collections from the lowest Miocene to the Recent fauna, rarely sees the evolution of marine invertebrates. He sees only the sudden appearance of forms, and equally sudden disappearance of the same, without knowing whence they came, or how they disappeared.

This could be used as an argument for saltatory or spasmodic evolution. But it could be used equally well as an argument for special creation. In fact, the paleontologist does not see here any spasmodic evolution; he sees only sudden appearance. The species appear before us in the rocks, without any previous record or credentials as to their history—presumably as immigrants, having been evolved somewhere else. They live on a while, and disappear a few at a time.

In the few cases where there is even a suggestion of evolution of species, this is not spasmodic, but slow and regular. In the Venus shells there is a probable genetic series, from *Chione temblorensis* in the lower Miocene, through *Chione securis* in the middle and upper part of the Miocene, to the group of *Chione succincta* of the Pliocene, Quaternary, and Recent faunas.

An equally good genetic series is seen in the development of *Pecten andersoni* of the lower Miocene into *Pecten discus* and *Pecten pabloensis* of the upper Miocene.

Another probable genetic series is that of the group of "Janira"; namely, *Pecten sanctaecruzensis* of the lower Miocene, *Pecten bellus* of the Pliocene, and *Pecten excavatus* of the Quaternary and Recent faunas. In this case there was a gradual retreat southward as the climate grew cooler, and the modern representatives are almost entirely confined to warmer waters. In addition to these, nearly fifty other species in the Recent fauna can be traced somewhat doubtfully into Miocene ancestors.

The tables of the occurrence and range of the Miocene species of California are based on a critical study of all the literature, and a critical examination of extensive collections from all the Miocene localities in California. Of course the list is not complete, for there are many undescribed species in the collections of the U. S. National Museum, of the University of California, of the California Academy of Sciences, and of Stanford University. Also some species that are now put together may not be synonyms, and very certainly some that are now treated separately will eventually be merged.

Further examination of better material will probably show that some of the Miocene species, now considered as identical with Recent forms, are different. And further collection will probably bring to light more Recent species in the Miocene faunas. But none of this will change materially the figures and percentages given. The numbers are too large, and the collections already made are too extensive for that to be the case.

It is hoped that this list will be of use to students of Californian stratigraphy, for whom it was prepared. Each one can do something towards completing it, by adding new species as they are described, checking the occurrence of old species, correcting the synonymy, and inserting names that have been omitted.

In the check-list the Temblor and Monterey faunas are entered separately as a matter of record, although they are certainly synchronous. The lower Pliocene faunas are merged under the name *San Diego-Purisima* for convenience of reference; and the upper Pliocene is recorded under the name *Santa Barbara,* because it is by no means certain that the name *Merced,* which has been used for the upper Pliocene, is applicable in southern California. The name *Fernando,* which has been extensively used in listing the faunas of southern California, is not applicable, for it has included faunas from lowest Pliocene to middle Quaternary in age.

CHECK-LIST OF MIOCENE INVERTEBRATES OF CALIFORNIA

GENERA AND SPECIES	OLIGOCENE	MIOCENE					PLIOCENE		QUATERNARY	
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	RECENT
Astrangia coalingensis Vaughan						×				
Favia merriami Vaughan						×				
Stephanocoenia fairbanksi Vaughan						×				
Amphiura sanctaecrucis Arnold					×					
Asterias remondi Gabb					×					
Astrodapsis antiselli Conrad					×					
Astrodapsis antiselli, var. *arnoldi* Pack					×					
Astrodapsis jacalitosanus Arnold					×					
Astrodapsis fernandoensis Pack				×						
Astrodapsis tumidus Remond					×					
Astrodapsis whitneyi Remond					×					
Scutaster andersoni Pack					×					
Scutella fairbanksi Arnold		×								
Scutella merriami Anderson			×							
Scutella perrini Weaver						×	×			
Scutella norrisi Pack		×								
Scutella breweriana Remond				×						
Scutella gibbsi Remond				×	×	×	×			
Scutella gibbsi, var. *ashleyi* Arnold						×	×			
Clypeaster bowersi Weaver						×				
Clypeaster gabbi Remond					×					
Linthia californica Weaver			×							
Terebratalia kennedyi Dall		×								
Terebratalia occidentalis Dall		×			×	×	×			×
Terebratalia Smithi Arnold						×	×	×		
Discinisca oregonensis Dall			×	×	×					
Balanus concavus Brown		×			×	×	×	×	×	×
Balanus estrellanus Conrad					×					
Tamiosoma gregaria Conrad				?	×					
Anomia subcostata Conrad						×				
Arca canalis Conrad					×		×	×		
Arca microdonta Conrad		×	×	×	×					
Arca montereyana Osmont			×	×						
Arca obispoana Conrad			×	×	×					
Arca osmonti Dall			×							
Arca trilineata Conrad			×		×	×	×	×		
Arca schizotoma Dall						×	×	×		
Arcopagia unda Conrad					×					
Cardium coosense Dall						×	×			
Cardium meekanum Gabb					×	×	×			

CHECK-LIST OF MIOCENE INVERTEBRATES OF CALIFORNIA—*Continued.*

GENERA AND SPECIES	OLIGOCENE	MIOCENE					PLIOCENE		QUATERNARY	RECENT
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	
Cardium quadrigenarium Conrad....			×	×	×	×		×	×	×
Cardium vaquerosense Arnold.......		×	×							
Chama pellucida Sowerby...........						×		×	×	×
Chione conradiana Anderson		×	×							
Chione mathewsoni Gabb............		×	×	×						
Chione securis Shumard			×	×	×	×	×			
Chione staleyi Gabb................				×	×	×	×			
Chione temblorensis Anderson		×	×	×	×					
Clidiophora punctata Conrad........					×	×	×		×	×
Corbicula dumblei Anderson			×							
Cryptomya ovalis Conrad					×	×	×			
Cryptomya quadrata Arnold.........						×	×			
Cumingia californica Conrad						×	×	×	×	×
Cyrena californica Gabb............					×					
Cytherea diabloensis Anderson......			×	?	×					
Diplodonta harfordi Anderson.......					×	×				
Diplodonta parilis Conrad...........					×	×				
Dosinia jacalitosana Arnold.........					×					
Dosinia ? longula Conrad					?					
Dosinia mathewsoni Gabb...........		×	×	×						
Dosinia montana Conrad............					?					
Dosinia ponderosa Gabb.............			×	×	×	×	×		×	×
Dosinia subobliqua Conrad..........					?					
Dosinia conradi Gabb...............		×								
Gari alata Gabb.....................					×					
Glycimeris barbarensis Conrad			×							
Glycimeris branneri Arnold		×	×							
Glycimeris coalingaensis Arnold.....					×	×				
Glycimeris septentrionalis Midd......						×			×	×
Hemimactra lenticularis Gabb.......			×							
Hinnites crassus Conrad					×					
Hinnites giganteus Gray............		×	×		×	×			×	×
Lucina estrellana Conrad............					×					
Macoma calcarea Gmelin............			×	×		×	×	×	×	×
Macoma inquinata Deshayes				×		×	×	×	×	×
Macoma astori Dall..................						×	×			
Macoma jacalitosana Arnold........					×					
Macoma nasuta Conrad.............	×	×	×	×	×	×	×	×	×	×
Macoma piercei Arnold			×							
Macoma secta Conrad..............			×		×	×	×		×	×
Macoma vanvlecki Arnold...........				×	×					

Check-List of Miocene Invertebrates of California—*Continued.*

Genera and Species	Oligocene	Miocene					Pliocene		Quaternary	Recent
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	Recent
Macoma ocoyana Conrad			×							
Mactra albaria Conrad			×	×	×		×			
Mactra catilliformis Conrad			×	×			×		×	×
Mactra coalingaensis Arnold						×				
Mactra montereyana Arnold				×						
Marcia oregonensis Conrad	×		×		×		×			
Meretrix uniomeris Conrad						?				
Meretrix traski Conrad				×						
Meretrix decisa Conrad			×							
Metis alta Conrad			×		×	×	×		×	×
Modiolus capax Conrad					×		×			×
Modiolus directus Dall						×				
Modiolus multiradiatus Gabb				×	×					
Modiolus rectus Conrad					×	×	×	×	×	×
Modiolus ynezanus Arnold	×	×								
Monia macroschisma Deshayes					×					×
Mulinia densata Conrad			×		×	×				
Mulinia, var. *minor* Arnold			×							
Mya japonica Jay						×				×
Mytilus coalingaensis Arnold					×	×				
Mytilus inezensis Conrad		?								
Mytilus mathewsoni Gabb		×	×	×	×					
Mytilus mathewsoni, var. *expansa* Arnold		×	×							
Nucula castrensis Hinds					×	×	×	×	×	×
Nucula conradi Meek			×							
Ostrea atwoodi Gabb					×	×				
Ostrea bourgeoisi Gabb					×					
Ostrea eldridgei Arnold		×	×							
Ostrea heermanni Conrad						×				
Ostrea panzana Conrad					×					
Ostrea lurida Carpenter						×			×	×
Ostrea tayloriana Gabb			?							
Ostrea titan Conrad		×	×	×	×					
Ostrea veatchii Gabb						×	×			
Ostrea vespertina Conrad						×				
Ostrea vespertina, var. *sequens* Arnold						×				
Leda cahillensis Arnold			×							
Leda taphria Dall			×	×			×		×	×
Pandora scapha Gabb			×							

Check-List of Miocene Invertebrates of California—*Continued.*

Genera and Species	Oligocene	Miocene					Pliocene		Quaternary	
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	Recent
Panopaea generosa Gould			×	×	×	×	×		×	×
Panopaea estrellana Conrad		×	×		×					
Paphia jacalitosana Arnold					×					
Paphia tenerrima Carpenter					×	×	×		×	×
Paphia staminea Carpenter					×		×		×	×
Paphia truncata Gabb					×					
Pecten andersoni Arnold			×	×	×					
Pecten branneri Arnold	×	×	×							
Pecten carrizoensis Arnold						×				
Pecten cerrosensis Gabb						×	×			
Pecten cerrosensis, var. *mendenhalli* Arnold						×				
Pecten coalingaensis Arnold						×				
Pecten crassicardo Conrad		×	×	×	×					
Pecten crassicardo, var. *hamiltoni* Arnold			×							
Pecten deserti Conrad						×				
Pecten discus Conrad				×	×					
Pecten eldridgei Arnold					×					
Pecten estrellanus Conrad		×	×		×					
Pecten estrellanus var. *catalinae* Arnold					×					
Pecten estrellanus var. *terminus* Arnold					×					
Pecten etchegoini Anderson						×				
Pecten hamlini Arnold			×							
Pecten hastatus Sowerby						×	×	×	×	×
Pecten keepi Arnold						×				
Pecten lompocensis Arnold		×	×							
Pecten magnolia Conrad		×								
Pecten miguelensis Arnold		×	×							
Pecten nevadanus Conrad		×	×							
Pecten nutteri Arnold						×	×			
Pecten oweni Arnold					×	×	×			
Pecten pabloensis Conrad					×					
Pecten peckhami Gabb		×		×						
Pecten perrini Arnold		×	×							
Pecten propatulus Conrad			×							
Pecten sanctaecruzensis Arnold	×	×	×							
Pecten sespeensis Arnold		×	×							
Pecten sespeensis, var. *Hydei* Arnold		×	×							
Pecten stanfordensis Arnold				×						

Check-List of Miocene Invertebrates of California—*Continued.*

Genera and Species	Oligocene	Miocene					Pliocene		Quaternary	
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	Recent
Pecten vanvlecki Arnold		×								
Pecten vaughani Arnold		×								
Pecten veatchi Gabb						×				
Pecten wattsi Arnold						×	×			
Periploma sanctaecrucis Arnold				×						
Phacoides acutilineatus Conrad		×	×	×		×				
Phacoides annulatus Reeve				×	×	×	×	×	×	×
Phacoides richthofeni Gabb		×	×	×			×			×
Phacoides sanctaecrucis Arnold		×	×	×			×			
Pholadidea ovoidea Gould						×				×
Placuanomia californica Arnold					×	×				
Pinna alamedensis Yates			×		×					
Psammobia edentula Gabb		×	×				×		×	×
Saxidomus nuttalli Conrad			×		×	×	×	×	×	×
Saxidomus vaquerosensis Arnold			×							
Semele rubropicta Dall						×				×
Schizodesma abscissa Gabb					×					
Schizothoerus pajaroanus Conrad					×	×	×			
Septifer coalingaensis Arnold			×							
Siliqua nuttalli Conrad					×	×	×	×	×	×
Solen sicarius Gould			×	×	×		×			×
Tapes inezensis Conrad		?								
Tellina aragonia Dall					×					
Tellina congesta Conrad				×						
Tellina idae Dall			×					×	×	×
Tellina oregonensis Conrad			×							
Tivela inezana Conrad		×	×		×					
Thracia jacalitosana Arnold					×					
Thracia mactropsis Conrad				×						
Thracia trapezoidea Conrad			×			×	×			
Transenella californica Arnold						×				
Venus pertenuis Gabb		×	×		×		×			
Venericardia montereyana Arnold				×						
Venericardia ventricosa Gould						×	×	×	×	×
Yoldia cooperi Gabb					×		×		×	×
Yoldia impressa Conrad	×		×							
Yoldia oregona Shumard			×							
Yoldia submontereyensis Arnold			×							
Yoldia supramontereyensis Arnold				×						
Zirphea dentata Gabb			×		×					
Zirphea gabbi Tryon					×	×	×		×	×
Agasoma barkerianum Cooper		×	×	×						

CHECK-LIST OF MIOCENE INVERTEBRATES OF CALIFORNIA—*Continued.*

GENERA AND SPECIES	OLIGOCENE	MIOCENE					PLIOCENE		QUATERNARY	
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	RECENT
Agasoma gravidum Gabb		×	×							
Agasoma santacruzanum Arnold			×							
Agasoma sinuatum Gabb				×						
Ancillaria fishii Gabb			×							
Astyris richthofeni Gabb						×				
Bathytoma carpenteriana Gabb						×	×		×	×
Bathytoma carpenteriana, var. *fernandoensis* Arnold						×	×			
Bathytoma coalingaensis Arnold						×				
Bathytoma keepi Arnold			×							
Bathytoma piercei Arnold			×							
Bittium asperum Gabb					×			×	×	×
Bullia anglonana Anderson			×							
Calliostoma coalingaense Arnold						×				
Calliostoma kerri Arnold						×				
Cancellaria altispira Gabb				×						
Cancellaria andersoni Arnold			×							
Cancellaria condoni Anderson			×							
Cancellaria joaquinensis Anderson			×							
Cancellaria dalliana Anderson			×							
Cancellaria pacifica Anderson			×							
Cancellaria simplex Anderson			×							
Cancellaria tritonidea Gabb						×	×	×	×	
Cancellaria vespertina Anderson					×					
Cancellaria vetusta Gabb			×							
Cerithium topangensis Arnold			×							
Chrysodomus imperialis Dall					×	×	×			
Chrysodomus portolaensis Arnold					×	×	×			
Conus owenianus Anderson			×							
Conus hayesi Arnold			×							
Crepidula onyx Sowerby					×		×		×	×
Crepidula praerupta Conrad			×		×					
Crepidula princeps Conrad		×	×		×	×	×	×	×	
Cuma biplicata Gabb		×	×							
Cylichna petrosa Conrad				×						
Dentalium conradi Dall			×							
Ficus kernianus Cooper		×	×	×						
Ficus nodiferus Gabb			×	×						
Ficus ocoyanus Conrad			×							
Ficus pyriformis Gabb			×	×						
Ficus stanfordensis Arnold			×	×						
Fusus portolaensis Arnold						×	×			

Check-List of Miocene Invertebrates of California—*Continued.*

Genera and Species	Oligocene	Miocene					Pliocene		Quaternary	
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	Recent
Fusus stanfordensis Arnold			×	×						
Goniobasis kettlemanensis Arnold						×				
Hemifusus wilkeseanus Anderson			×							
Littorina mariana Arnold						×				
Littorina planaxis Phill					×					×
Littorina remondi Gabb					×					
Lunatia lewisii Gould				×	×	×	×	×	×	×
Macron merriami Arnold			×							
Margarita johnsoni Arnold					×					
Metula remondi Gabb			×							
Miopleionia oregonensis Dall						×	×			
Monoceros engonatum Conrad					×					×
Nassa arnoldi Anderson			×							
Nassa californiana Conrad					×	×	×		?	×
Nassa californiana, var. *coalingaensis* Arnold						×				
Natica geniculata Conrad			×							
Natica inezana Conrad		×								
Neptunea recurva Gabb					×					
Neverita callosa Gabb		×	×		?					
Neverita recluziana Petit					×	×	×	×	×	×
Ocinebra topangensis Arnold			×							
Ocinebra lurida Midd					×	×	×		×	×
Oliva californica Anderson			×							
Oliva futheyana Anderson			×							
Olivella biplicata Sowerby						×	×	×	×	×
Olivella pedroana Conrad			×		×	×		×	×	×
Pachypoma biangulata Gabb		×	×		×					
Pisania fortis, var. *angulata* Arnold						×				
Pleurotoma transmontana Conrad			×							
Purpura vaquerosensis Arnold		×								
Ranella mathewsoni Gabb			×							
Scaphander jugularis Conrad			×							
Sigaretus scopulosus Conrad	×		×			×				
Sigaretus perrini Arnold			×							
Terebra cooperi Anderson			×							
Thais canaliculata Ducl					×			×	×	×
Thais crispata Chem					×	×	×		×	×
Thais edmondi Arnold			×							
Thais etchegoinensis Arnold						×				
Thais kettlemanensis Arnold					×	×				
Trochita costellata Conrad		×	×	×						

CHECK-LIST OF MIOCENE INVERTEBRATES OF CALIFORNIA—*Continued.*

GENERA AND SPECIES	OLIGOCENE	MIOCENE					PLIOCENE		QUATERNARY	
		Lower			Upper		Lower	Upper		
	San Lorenzo	Vaqueros	Temblor	Monterey	San Pablo-Sta. Margarita	Etchegoin	San Diego-Purisima	Sta. Barbara	San Pedro	RECENT
Trochita diegoana Conrad						?				
Trochita filosa Gabb			×		×		×			
Trochita inornata Gabb				×	×		×			
Trophon bartoni Arnold			×							
Trophon carisaensis Anderson				×	×					
Trophon coalingaensis Arnold						×				
Trophon gabbianus Anderson			×							
Trophon gabbianus, var. *cancellarioides* Arnold			×							
Trophon kernensis Anderson			×							
Trophon ponderosus Gabb				×	×	×				
Trophon stuarti Smith						×		×	×	×
Turbo topangensis Arnold			×							
Turritella inezana Conrad		×								
Turritella inezana, var. *sespeensis* Arnold		×								
Turritella ocoyana Conrad			×							
Turritella vanvlecki Arnold					×	×				
Turritella variata Conrad			×							
Vanikoro diegoana Conrad						?				
Triptera clavata Gabb			×							

SPECIES CONFINED TO THE LOWER MIOCENE—VAQUEROS, TEMBLOR, AND MONTEREY FAUNAS

GENERA AND SPECIES	San Lorenzo	Vaqueros	Temblor	Monterey
Linthia californica Weaver			×	
Astrodapsis fernandoensis Pack				×
Scutella fairbanksi Arnold		×		
Scutella merriami Anderson			×	
Scutella norrisi Pack		×		
Scutella breweriana Gabb				×
Terebratalia kennedyi Dall		×		

Species Confined to the Lower Miocene—*Continued*

Genera and Species	San Lorenzo	Vaqueros	Temblor	Monterey
✓*Arca montereyana* Osmont			×	×
Arca obispoana Conrad			×	×
Arca osmonti Dall			×	
✓*Cardium vaquerosense* Arnold		×	×	
Chione conradiana Anderson		×	×	
Chione mathewsoni Gabb		?	×	×
✓*Corbicula dumblei* Anderson			×	
Dosinia conradi Gabb		×		
Dosinia mathewsoni Gabb		×	×	×
Glycimeris barbarensis Conrad			×	
✓*Glycimeris branneri* Arnold		×	×	
Hemimactra lenticularis Gabb			×	
Leda cahillensis Arnold			×	
Macoma piercei Arnold			×	
Macoma ocoyana Conrad			×	
Mactra montereyana Arnold				×
Meretrix decisa Conrad			×	
Modiolus ynezanus Arnold	×	×		
Mytilus inezensis Conrad		×		
✓*Mytilus mathewsoni* Gabb, var. *expansa* Arnold		×	×	
Nucula conradi Meek			×	
Ostrea eldridgei Arnold		×	×	
Pandora scapha Gabb			×	
Periploma sanctaecrucis Arnold				×
Pecten branneri Arnold	×	×	×	
Pecten hamlini Arnold			×	
Pecten lompocensis Arnold		×	×	
✓*Pecten magnolia* Conrad		×		
Pecten nevadanus Conrad		×	×	
Pecten peckhami Gabb	×	×		×
✓*Pecten perrini* Arnold		×	×	
Pecten propatulus Conrad			×	
Pecten sanctaecruzensis Arnold	×		×	
Pecten sespeensis Arnold		×	×	
Pecten sespeensis, var. *hydei* Arnold		×	×	
Pecten stanfordensis Arnold				×
Pecten vanvlecki Arnold		×		
Pecten vaughani Arnold		×		
Saxidomus vaquerosensis Arnold			×	
Septifer coalingaensis Arnold			×	
Tapes inezensis Conrad		?		
Tellina congesta Conrad				×
Tellina oregonensis Conrad			×	
Yoldia impressa Conrad	×		×	
Yoldia oregona Shumard			×	
Yoldia submontereyensis Arnold			×	
Yoldia supramontereyensis Arnold				×
✓*Agasoma barkerianum* Cooper		×	×	×
Agasoma gravidum Gabb			×	
✓*Agasoma santacruzanum* Arnold			×	
Agasoma sinuatum Gabb				×

SPECIES CONFINED TO THE LOWER MIOCENE—*Continued*

GENERA AND SPECIES	San Lorenzo	Vaqueros	Temblor	Monterey
Ancillaria fishii Gabb			×	
Bathytoma keepi Arnold			×	
Bathytoma piercei Arnold			×	
Bullia anglonana Anderson			×	
Cancellaria altispira Gabb				×
Cancellaria andersoni Arnold			×	
Cancellaria condoni Anderson			×	
Cancellaria dalliana Anderson			×	
Cancellaria joaquinensis Anderson			×	
Cancellaria pacifica Anderson			×	
Cancellaria simplex Anderson			×	
Cancellaria vetusta Gabb			×	
Cerithium topangensis Arnold			×	
Conus hayesi Arnold			×	
Conus owenianus Anderson			×	
Cuma biplicata Gabb		×	×	
Cylichna petrosa Conrad				×
Dentalium conradi Dall			×	
Ficus kernianus Cooper		×	×	×
Ficus nodiferus Gabb			×	×
Ficus ocoyanus Conrad			×	
Ficus pyriformis Gabb			×	×
Ficus stanfordensis Arnold			×	×
Fusus stanfordensis Arnold			×	×
Hemifusus wilkesanus Anderson			×	
Metula remondi Gabb			×	
Macron merriami Arnold			×	
Nassa arnoldi Anderson			×	
Natica geniculata Conrad			×	
Natica inezana Conrad		×		
Ocinebra topangensis Arnold			×	
Oliva californica Anderson			×	
Oliva futheyana Anderson			×	
Pleurotoma transmontana Conrad			×	
Pupura vaquerosensis Arnold		×		
Ranella mathewsoni Gabb			×	
Scaphander jugularis Conrad			×	
Sigaretus perrini Arnold			×	
Terebra cooperi Anderson			×	
Thais edmondi Arnold			×	
Trochita castellata Conrad		×	×	×
Trophon bartoni Arnold			×	
Trophon gabbianus Anderson			×	
Trophon gabbianus, var. *cancellarioides* Arnold			×	
Trophon kernensis Anderson			×	
Turbo topagensis Arnold			×	
Turritella inezana Conrad		×		
Turritella inezana, var. *sespeensis* Arnold		×		
Turritella ocoyana Conrad			×	
Turritella variata Conrad			×	
Triptera clavata Gabb			×	

Species Confined to the Upper Miocene in California—Santa Margarita, Jacalitos, San Pablo and Etchegoin Faunas

Genera and *Species*	Santa Margarita	Etchegoin
Astrangia coalingaensis Vaughan		×
Favia merriami Vaughan		×
Stephanocoenia fairbanksi Vaughan		×
Amphiura sanctaecrucis Arnold	×	
Asterias remondi Gabb	×	
Astrodapsis antiselli Conrad	×	
Astrodapsis tumidus Remond	×	
Astrodapsis whitneyi Remond	×	
Clypeaster bowersi Weaver		×
Clypeaster gabbi Remond	×	
Anomia subcostata Conrad		×
Arcopagia unda Conrad	×	
Cyrena californica Gabb	×	
Diplodonta harfordi Anderson	×	×
Diplodonta parilis Conrad	×	×
Dosinia jacalitosana Arnold	×	
Gari alata Gabb	×	
Glycimeris coalingaensis Arnold	×	×
Hinnites crassus Conrad	×	
Lucina estrellana Conrad	×	
Macoma jacalitosana Arnold	×	
Mactra coalingaensis Arnold		×
Meretrix uniomeris Conrad		?
Modiolus directus Dall		×
Mya japonica Jay		×
Mytilus coalingaensis Arnold	×	×
Ostrea atwoodi Gabb	×	×
Ostrea bourgeoisi Gabb	×	
Ostrea heermanni Conrad		×
Ostrea pansana Conrad	×	
Ostrea vespertina Conrad		×
Ostrea vespertina, var. *sequens* Arnold		×
Paphia jacalitosana Arnold	×	
Paphia truncata Gabb	×	
Pecten carrizoensis Arnold		×
Pecten deserti Conrad		×
Pecten eldridgei Arnold	×	
Pecten etchegoini Anderson		×
Pecten keepi Arnold		×
Pecten pabloensis Conrad	×	
Pecten veatchi Gabb	×	
Placunanomia californica Arnold	×	×
Schizodesma abscissa Gabb	×	×
Siliqua nuttalli Conrad		×
Tellina aragonia Dall	×	
Thracia jacalitosana Arnold	×	
Transenella californica Arnold		×

SPECIES CONFINED TO THE UPPER MIOCENE IN CALIFORNIA—SANTA MARGARITA, JACALITOS, SAN PABLO AND ETCHEGOIN FAUNAS—*Continued*

GENERA AND SPECIES	Santa Margarita	Etchegoin
Astyris richthofeni Gabb		×
Bathytoma coalingaensis Arnold		×
Calliostoma coalingaense Arnold		×
Calliostoma kerri Arnold		×
Cancellaria vespertina Anderson	×	
Goniobasis kettlemanensis Arnold		×
Littorina remondi Gabb	×	
Littorina mariana Arnold		×
Margarita johnsoni Arnold	×	
Nassa californiana, var. *coalingaensis* Arnold		×
Neptunea recurva Gabb	×	
Pisania fortis, var. *angulata* Arnold		×
Thais etchegoinensis Arnold		×
Thais kettlemanensis Arnold	×	×
Turritella vanvlecki Arnold	×	×
Trophon coalingaensis Arnold		×

LIST OF MIOCENE SPECIES THAT ARE STILL LIVING

GENERA AND SPECIES	San Lorenzo	Vaqueros	Temblor	Monterey	Santa Margarita	Etchegoin	San Diego-Purisima	Santa Barbara	Quaternary	Living
Terebratalia occidentalis Dall		×			×	×	×			×
Balanus concavus Brown		×			×	×	×	×		×
Cardium quadrigenarium Conrad			×	×	×	×		×	×	×
Chama pellucida Sowerby						×			×	×
Clidiophora puctata Conrad					×	×	×		×	×
Cumingia californica Conrad						×	×	×	×	×
Dosinia ponderosa Gabb			×	×	×	×	×		×	×
Glycimeris septentrionalis Midd						×			×	×
Hinnites giganteus Gray		×	×		×	×			×	×
Macoma calcarea Gmelin			×	×		×	×	×	×	×
Macoma inquinata Deshayes						×	×	×	×	×
Macoma secta Conrad			×		×	×	×		×	×
Macoma nasuta Conrad		×	×	×	×	×	×	×	×	×
Mactra catilliformis Conrad	×		×	×					×	×
Metis alta Conrad			×		×		×		×	×
Modiolus capax Conrad					×				×	×
Modiolus rectus Conrad					×	×	×		×	×
Monia macroschisma Deshayes					×		×	×	×	×
Mya japonica Jay						×				×

List of Miocene Species that are Still Living—*Continued*

Genera and Species	San Lorenzo	Vaqueros	Temblor	Monterey	Santa Margarita	Etchegoin	San Diego-Purisima	Santa Barbara	Quaternary	Living
Nucula castrensis Hinds					×	×	×	×	×	×
Ostrea lurida Carpenter						×	×		×	×
Leda taphria Dall			×	×			×		×	×
Panopœa generosa Gould			×	×	×	×	×	×	×	×
Paphia tenerrima Carpenter					×	×	×		×	×
Paphia staminea Carpenter					×		×	×	×	×
Pecten hastatus Sowerby						×	×	×	×	×
Phacoides annulatus Reeve				×	×	×	×	×	×	×
Psammobia edentula Gabb		×	×				×		×	×
Phacoides richthofeni Gabb		×	×	×			×			×
Pholadidea ovoidea Gould						×	×			×
Tellina idae Dall			×					×	×	×
Saxidomus nuttalli Conrad			×		×	×	×	×	×	×
Semele rubropicta Dall						×			×	×
Siliqua nuttalli Conrad					×		×		×	×
Solen sicarius Gould			×	×	×		×	×	×	×
Venericardia ventricosa Gould						×	×	×	×	×
Yoldia cooperi Gabb					×		×		×	×
Zirphea gabbi Tryon					×	×	×		×	×
Bathytoma carpenteriana Gabb						×	×		×	×
Bittium asperum Gabb					×			×	×	×
Crepidula onyx Sowerby					×		×		×	×
Littorina planaxis Phill					×					×
Lunatia lewisii Gould				×	×	×	×	×	×	×
Nassa californiana Conrad					×	×		?	?	?
Neverita recluziana Petit					×	×	×	×	×	×
Ocinebra lurida Midd					×	×	×		×	×
Olivella biplicata Sowerby						×	×	×	×	×
Olivella pedroana Conrad			×		×	×		×	×	×
Thais canaliculata Ducl					×		×		×	×
Thais crispata Chem					×	×	×		×	×
Trophon stuarti Smith						×		×	×	×

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

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DESCRIPTION OF A NEW GENUS AND SPECIES OF SALAMANDER FROM JAPAN

BY SURGEON J. C. THOMPSON, U. S. NAVY

PLATE XIV

The California Academy of Sciences has received from the Far East a tailed batrachian belonging to the subfamily of Amblystomatinæ. It is intermediate between the groups composed of *Hynobius* Tschudi and *Salamandrella* Dybowski on the one hand and of *Onychodactylus* Tschudi and *Geomolge* Boulenger on the other.

The larvæ possess stout claws, which is also the condition found in the young of *Geomolge*. The development of the dermal covering of the palms and soles is unique among salamanders.

Pachypalaminus new genus

Type.—Pachypalaminus boulengeri, No. 33192 California Academy of Sciences.

Generic Characters.—Tongue large, with longitudinal plicæ and sulci and with anterior and lateral borders free. Series of palatine teeth interrupted, forming a pair of salient angles, with mesial sides the longer. Palms, soles, and inferior surface and tips of fingers and toes covered with a tough brown corneous modification of the epidermis. Toes five. Tail compressed at the base, deepened and strongly compressed posteriorly.

The following species is dedicated to Mr. G. A. Boulenger, F. R. S., V. P. Z. S., as a slight token of the appreciation felt for assistance rendered me when a student in London.

Pachypalaminus boulengeri new species

Type.—No. 33192 California Academy of Sciences; male; Odaigahara Mt., Yamato Province, Honshu, Japan; October, 1911.

Specific Characters.—Head large, depressed, and as broad as long; snout long and rounded; nostril situated a trifle nearer to the orbit than to the tip of the snout; eyes rather large and prominent; orbit contained one and one third times in the length of the snout. Series of palatine teeth interrupted, not forming a reëntrant angle; apices of the two salient angles on a line with the centers of the choanæ; the length of the inner side of one of the angles equal to the interval between the choanæ; the length of the outer side equal to one third this interval. Tongue circular, strong and fleshy, filling the floor of the mouth, the surface finely and longitudinally plicate; two fairly deep sulci with a general antero-posterior trend, their outline that of two laterally directed obtuse angles, enclosing about one half the central area of the tongue. The gular fold moderately developed. Body depressed; distance from the snout to the gular fold contained nearly three times in the distance from the latter to the cloaca; median dorsal groove, markedly deepened over the pectoral and pelvic regions; thirteen well developed costal folds, including the one flexed to enter the axilla and the one reaching the groin; the nine middle folds continued across the abdomen. Vent (of male) three slits meeting in front, the medium longitudinal and longest, the two others obliquely directed forwards, forming an angle; the borders swollen. Limbs stout, when adpressed the digits overlap for about two millimeters. Digits well developed. Tail a trifle longer than the distance from the gular fold to the cloaca, strongly compressed, deepened and fleshy in the posterior half; not keeled; the tip rounded. Skin smooth; numerous mucous glands on snout, around nostrils and eyes, and on upper and lower lips; parotids distinct; an irregular horizontal groove from eye to gular fold, joined by a short vertical one posterior to angle of mouth. Color in spirits slate, a trifle paler beneath.

MEASUREMENTS (in millimeters)

Total length	161
From snout to cloaca	92
From snout to gular fold	23
From snout to level of centre of insertion of fore limb	35
From snout to level of centre of insertion of hind limb	88
From axilla to groin	44
Fore limb	23
Hind limb	26
Head	18.5
Width of head	19
From snout to nostril	5
Interval between nostrils	7.3
From snout to centre of eye	10
Interorbital	4.3
Interval between anterior canthi	9
Interval between posterior canthi	13.5
From anterior canthus to nostril	4
From snout to angle of mouth	15
Tail	69

	Depth	Width
At base of tail	12	11.5
At end of first quarter of tail	10.5	9.5
At end of second quarter of tail	12.5	6.5
At end of third quarter of tail	15.5	4.5

Series of palatine teeth:

Length (measured along mesial side of one salient angle)	6
Width (interval between extremities of lateral sides of salient angles)	6.8
Interval between apices of salient angles	4
Length of short lateral side of a salient angle	2
Interval between posterior extremities of mesial sides of each salient angle	1.5

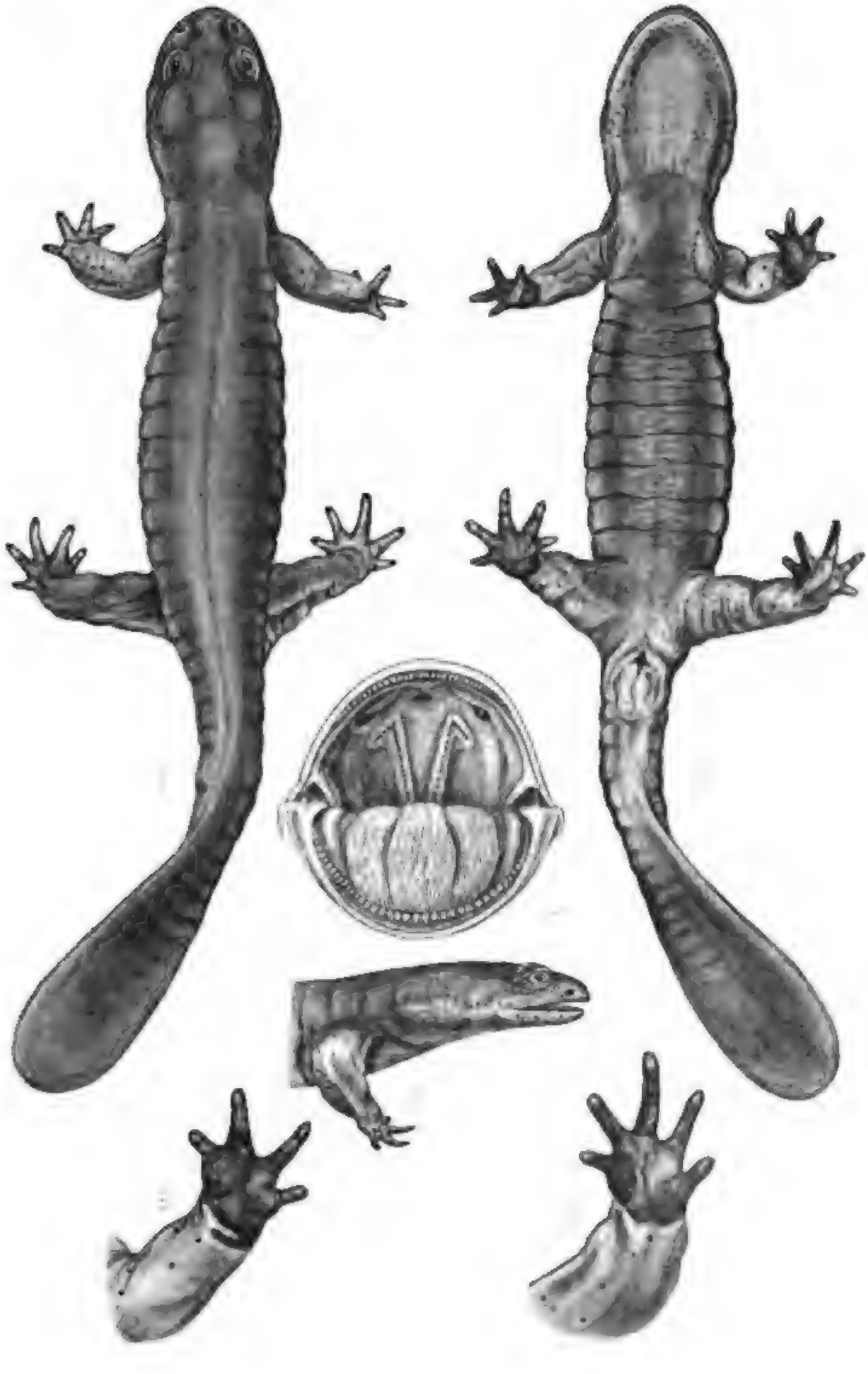
California Academy of Sciences,
April 23, 1912.

EXPLANATION OF PLATE XIV

Pachypalaminus boulengeri new species.

Type: No. 33192 California Academy of Sciences; male; Odaigahara Mt., Yamato Province, Honshu, Japan.

Figures 1, 2, 3 natural size; 4, 5, 6 enlarged two times.



PROCEEDINGS

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CALIFORNIA ACADEMY OF SCIENCES

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CONCERNING CERTAIN SPECIES OF REPTILES AND AMPHIBIANS FROM CHINA, JAPAN, THE LOO CHOO ISLANDS, AND FORMOSA

By JOHN VAN DENBURGH

Curator of the Department of Herpetology

CONTENTS

December 13, 1912.

INTRODUCTION

This paper is made up of a series of notes upon collections of reptiles and amphibians from China and the Japanese Empire, which the Academy has received during recent years. It is not in any sense an exhaustive account of these collections. Instead, it deals only with certain species, nearly all of which have been collected by Victor Kühne in Formosa and the Loo Choo Archipelago. A few species from China, Japan proper, the Pescadores, Botel Tobago, Wake, and the Bonin islands also are included; but a large proportion of the species, even from Formosa and the Loo Choo Islands, have not been studied at all.

One genus and the following species and subspecies are here first described, although advance diagnoses of these forms were published July 29, 1912.*

Hyla hallowelli
Japalura polygonata ishigakiensis
Japalura polygonata miyakensis
Eumeces barbouri
Eumeces marginatus amamiensis
Eumeces marginatus kikaigensis
Eumeces ishigakiensis
Eumeces chinensis formosensis
Sphenomorphus indicus formosensis
Sphenomorphus boulengeri
Leiolopisma laterale formosensis
Leiolopisma laterale boettgeri
Lygosaurus pellopleurus browni
Takydromus stejnegeri
Achalinus werneri
Calliophis swinhoei

From a study so incomplete as this, it is indeed difficult to draw conclusions of value regarding the past changes in the land and water areas of the region involved. We may, however, state rather positively that changes have been more numerous, and land-connections more complicated, than in the Galapagos Archipelago. Although not here set forth, there

* Advance Diagnoses of New Reptiles and Amphibians from the Loo Choo Islands and Formosa. Published San Francisco, July 29, 1912.

is evidence that Sakhalin has been rather recently connected with continental Asia. The various islands of Japan proper bear evidence of having been joined not only with each other but also with Sakhalin and Korea by way of Iki and Tsushima. The Loo Choo Islands probably are quite old. The majority of their reptiles and amphibians apparently reached them from the south, doubtless by way of a continental connection of which the present island of Formosa formed a part. The northern islands, however, must sometime have been united with Japan proper; as is shown, for instance, by the presence of *Eumeces barbouri*. The islands of this group were doubtless all connected for a considerable period—long enough to develop specific differences, such as exist between *Eumeces marginatus* and *Eumeces elegans*. Later they became separated into the various islands, and have had individual existence for a period long enough to permit subspecific, or in some instances specific, differentiation. The southern islands show the Formosan influence upon their fauna more strongly than the central and northern islands. The major portion of Formosa is occupied by a reptilian fauna which is practically Chinese modified by time and isolation. Southern Formosa, however, bears evidence of a former connection with the Philippines by way of Botel Tobago—as is shown, for example, by *Sphenomorphus boulengeri*.

From all this it would seem probable that this whole region has been gradually sinking; that formerly these various islands were united, as it were, into an enormous "barrier reef" off the whole eastern coast of Asia, and connected with that continent through Sakhalin, Korea and Formosa; that the Loo Choo portion of this "reef" then became separated from Japan, and later from Formosa; and that subsequent depression resulted in the present geographical conditions. Doubtless there have been minor elevations and depressions, more or less local in extent, resulting in temporary connections and isolations of portions of this area, and complicating the reading of the story in further detail.

Hyla chinensis Günther

Originally described from specimens from China, this was one of the species obtained by Swinhoe in Formosa. It has been recorded also from Taiwan, Formosa.

We have received twelve adult specimens from Formosa. In all, the heels overlap about the width of the tarsus. When carried forward, the heel reaches the anterior edge of the eye in five, the middle of the orbit in five, and the posterior edge in two. One specimen (No. 20075) twenty-six millimeters long from snout to vent, has no vomerine teeth. Two have only the left patch of vomerines. There is considerable variation in the number, shape, and distribution of the black markings on the legs and sides of body. One large specimen has no black markings. On the body there may be only one spot, a series of spots, or a continuous narrow line. On the legs the markings may be confined to the thighs, or may extend down to the feet; may be round, or may form longitudinal streaks. The brown streak in front and behind the eye seems to be constantly present. The vomerine teeth are a little farther back than in *Hyla arborea japonica* from Japan, but not farther than in the Loo Choo species. There seems to be no appreciable difference in the extent of the web.

Our specimens were collected at Kosempo, Keelung, Taihoku.

Hyla hallowelli Van Denburgh

Diagnosis.—Similar to *Hyla chinensis,* but never with black spots on legs and sides of body, and with only a trace of a dark streak on side of face; heels overlapping, tibio-tarsal articulation reaching anterior border of eye or beyond; tibia seldom less than half the length of head and body; no dark streak behind eye; green extending beyond wrist and ankle.

Type.—Adult male. California Academy of Sciences No. 23806. **Kikaiga shima, Loo Choo Islands, Japan,** April 30, 1910.

Description of the type.—Vomerine teeth in two small central groups between posterior edges of choanae. Tongue rounded, slightly indented, and free behind. Canthus rostralis distinct; loreal region slightly oblique and concave. Interorbital space much broader than the upper eyelid. Tympanum distinct, small, about half the diameter of eye. Fingers webbed at base. Toes webbed as in *H. chinensis.* Heels overlap about the width of

the tarsus when the legs are folded and held at right angles to the axis of body. Heel reaches a little beyond anterior border of eye. A strong dermal fold from eye to tympanum and along the side. A strong pectoral fold. Large external vocal sac.

The color above, in alcohol, is uniform bluish gray, doubtless green in life. This color extends down the upper surfaces of the limbs on to the external digits. There is a trace of a narrow gray line from nostril to eye. There are no other dark markings except a few indistinct gray dots on the sides of the body, the front of the thigh, and the back of the thigh and leg. The lower surfaces are uniform yellowish white, faintly clouded with gray on the vocal sac.

Variation.—With fifty-seven specimens at hand, but little variation appears. There is practically no variation in color. The dark spots of *H. chinensis* are always absent in this species. The heels overlap about the width of the tarsus in all these specimens. The heel reaches only to the middle of the eye in two, to the nostril in two, and to or slightly beyond the anterior edge of the eye in fifty-three. The tibia rarely is a little less than half the length of the head and body, but usually is more than half this measurement.

Relationship.—The slightly more posterior position of the vomerine teeth, the overlapping of the heels, the general shape of the head and body, and the uniform green coloration above, indicate relationship with *H. chinensis,* nothwithstanding the fact that the absence of the showy black spots and red-brown head-streak give a certain resemblance to the *Hyla* of Japan. The following measurements, first, of the type of this species, second, of a Formosan specimen of *H. chinensis,* and third, of a Japanese specimen of *Hyla arborea japonica,* may be useful. All are males.

Snout to vent	33 mm.	33.4 mm.	32.3 mm.
Snout to tympanum	9.5 "	9.3 "	9.4 "
Tympanum to vent	25. "	25.6 "	24. "
Width of head	11. "	11.2 "	13. "
Fore limb	23. "	22.5 "	23.5 "
Hind limb	55. "	51. "	52. "
Tibia ..'	18. "	16.5 "	15. "
Heel to tip of longest toe.	25 "	25. "	24. "

It will be seen that the new species has a much longer tibia, and that the Japanese form has a broader head.

Distribution.—No tree-toads have been recorded from any of the Loo Choo islands. We have received good series from Kikaiga and Amami Ō shima, but none from any other island of the group.

Rana okinavana Boettger

This frog was described by Boettger, in 1895, from three specimens secured by a Japanese collector for Mr. B. Schmacker. These were labeled Okinawa shima. The large collection which we have received from the Loo Choo Islands contains no specimens of this frog from Okinawa, where it was sought in vain; but on Ishigaki shima twenty-five specimens, which seem referable to this species were obtained.

Boettger's original description applies so completely that a detailed description of them seems uncalled for, but it will be well to call attention to certain variations occurring in the series now at hand.

The vomerine teeth normally begin about on a line connecting the posterior borders of the choanae—or a little anterior to this—and extend obliquely backward, being separated from each other and from the choanae by nearly equal spaces. Nineteen specimens show approximately this arrangement. Two specimens have the vomerine patches between the choanae (Nos. 22834 and 22845). One specimen (No. 22852) has the left patch much in advance of the right, so that the left is between, and the right chiefly behind, the choanae. One adult specimen (No. 22851) has no vomerine teeth, and two have them absent on one side.

In four specimens (Nos. 22851, 22838, 22847, 22852) the nostrils open about midway between the eye and the end of the snout. In the other twenty-one examples the nostrils are decidedly nearer to the end of the snout than to the eye. In No. 22846 the nostril is farthest forward.

The external metatarsal tubercle usually is not present, but five or six specimens (as Nos. 22851, 22835, 22852) show it as a distinct, small, round, white knob at the base of the fourth toe.

The skin usually is smooth everywhere except on the rump and hind legs, but in some specimens the sides bear small warts.

In two specimens (Nos. 22851 and 22852) the tibio-tarsal joints do not overlap. In six (Nos. 22841, 22853, 22847, 22838, 22842, 22835) they overlap one-half the width of the tarsus. In the other seventeen specimens they overlap the full width of the tarsus.

Nineteen specimens have a distinct mid-dorsal line. One (No. 22832) shows a mere indication of this line. Five are entirely without this light line.

Many of the specimens have the ends of the toes so much dilated that they might be said to bear pads.

The largest individuals have a length from snout to vent of 44 mm.

Rana ijimae Stejneger

This frog was described by Stejneger in 1901 from a single specimen preserved in the Science College, Tokyo, said to have been collected at Tanabinura, Okinawa shima. Careful collecting on Okinawa failed to bring to light any additional specimens, but on Ishigaki some ten specimens were secured which agree very well with Stejneger's type. For purposes of comparison I give the following description of the Ishigaki specimens:

Description.—Vomerine teeth in two oblique series, extending posteriorly from a line connecting the choanae, about equidistant from the latter and from each other; tongue without free conical papillae; snout somewhat projecting, nostrils much nearer to tip of snout than to eyes, and nearly over tip of lower jaw; interorbital space slightly narrower than upper eyelid; canthus rostralis well-marked; lores concave; tympanum one-half diameter of the eye; fingers free, first extending slightly beyond second, disks distinct, small, largest on third and fourth fingers, less than half diameter of tympanum; toes almost fully, or extensively, webbed; one or one and one-half terminal digits of fourth toe free, excision sometimes reaching to terminal third of basal phalanx of fourth toe; disks well-developed, a little less than half diameter of tympanum, about equal to or a little larger than those of fingers; subarticular tubercles very prominent; inner metatarsal tubercle oval, fairly well-developed, contained about two and one-half times in the distance from its distal border to the end of first toe; *no outer* metatarsal tubercle, except a mere thickening of skin in one specimen; no outer dermal fringe on fifth toe; no tarsal fold; tibio-tarsal articulation reaches *between eye and nostril* when the hind leg is carried forward, and overlaps about as much as the distance between eye and nostril; tibia equals or exceeds one-half length of head and body; skin of back usually smooth, occasionally with a few scattered tubercles; sides with numerous large tubercles interspersed with small ones; lores smooth or with asperities which sometimes are white tipped; similar asperities numerous on temporal regions and forming a ring about tympanum "like a string of pearls"; from two to four large glandular warts behind corner of mouth; dorso-lateral fold distinct, narrow or moderately broad, often not entirely continuous; under surfaces smooth except sometimes posteriorly and on thighs, where in many specimens they are granular.

The color in alcohol varies from dark slaty brown through chocolate brown, olive brown, and grayish cinnamon to a greenish or brownish gray.

The back usually is unicolor, but may have indefinite dark or light markings. The dorso-lateral fold may be light more or less edged with black (sometimes a complete line, sometimes only a few black dots), or the light streak may be absent. The edge of the lip is dark, but above this is a light streak, much more definite in some specimens than in others, which is continued on to the postoral tubercles. A dark line usually extends from the snout through the nostril, along the canthus rostralis and edge of upper eyelid to join the black edge of the dorso-lateral fold. The sides and limbs are lighter than the back. The former are spotted or blotched, and the latter are cross-barred with black or dark brown. There is a whitish pineal spot.

Number	22825	22827	22822	22820
Snout to vent ... mm.	48	69	88	99
Width of head	17	22.5	30	34
Distance between nostrils	5.5	7	8.5	10
Distance bet. nostrils and eyes	5	6	7	8.5
Diameter of eye	6	8	10	12
Diameter of tympanum	3.5	4.5	4.8	6
Interorbital space	4	5.2	6.5	9
Fore leg	31	44	51	59
Width of largest finger disk	1.3	1.8	2	2
Hind leg, vent to tip of longest toe	89	116	141	157
Tibia	29	36	45	52
Metatarsal tubercle	2	3	4	5

In one of the smaller specimens the tibio-tarsal joint reaches quite to the end of the snout.

Rana namiyei Stejneger

An excellent series of twenty-two specimens of this frog is now at hand from Nago, Okinawa.

These specimens agree in almost every particular with the description given by Dr. Stejneger. A few points of variation may be noted. The tooth-like prominences in the lower jaw are farther apart than indicated in the figure, and between them on the median line is a smaller prominence. The head may be as wide as Stejneger states but, especially in the younger specimens, may be considerably (diameter of orbit) narrower. The nostrils may be a little anterior to the point midway between the eye and the end of snout. The interorbital space may be one and one-half or only one and one-fourth times as wide as the upper eyelid. The length of the metatarsal tubercle usually is considerably shorter than the diameter of the eye. The tibio-tarsal joint may not reach the eye; it usually reaches the posterior border of the eye, but may extend to the anterior border. The heels usually are as described by Stejneger, but they may nearly meet. The skin

above may be nearly smooth, or may have numerous warts and transverse or longitudinal folds. There are small warts on the upper eyelids, especially posteriorly.

The color above, in alcohol, is brown, gray, or olive, with very indefinite darker cloudings on the back and limbs. When most clearly marked there seem to be three dark blotches on the back behind the head, and three cross-bars on the limbs. The upper surfaces of the limbs, the temporal regions, and the upper eyelids are sometimes more or less stained with orange or brick-red. Individual warts may be reddish or blackish. On the hind limbs there often are whitish asperities.

In these Loo Choo specimens the toes vary a little in length; but nevertheless it may be said that they constantly bear the relations described by Stejneger. The same proportions are seen in a good series of frogs from Formosa which I recorded under this name.[1] None of these Formosan frogs is quite as large as some of the specimens from Okinawa. Otherwise, upon direct comparison, the two series seem to be absolutely alike except in the following particulars: 1. The free dermal margin along the outer edge of the fifth toe is considerably more extensive in the Okinawa specimens. 2. In these specimens, also, the web is constantly more extensive than in those from Formosa. 3. In all the specimens from the Loo Choos the dark band which passes through the posterior half of the upper eyelids is broad, and is indefinite behind, while in the Formosan frogs this band is narrower, is sharply limited posteriorly, and has a smaller dark cross-band, blotch, or series of spots immediately behind it.

Since these differences are constant in a considerable series of specimens, it is evident that the frogs of Formosa and of Okinawa must be regarded as distinct, though very closely related, species. The name *Rana namiyei* must be restricted to the Loo Choo frogs, for it was from Okinawa shima that Stejneger's type came. What, then, are the frogs from Formosa? Are they *Rana kuhlii* or a new species? These questions I shall leave for future consideration.

Rana namiyei has been secured only on Okinawa shima. Here it was found in crevices and under the stones of brooks,

[1] Proc. Calif. Acad. Sci., (4), III, 1909, p. 55.

in deep and shaded valleys about three miles northeast of Nago. Its croak is a single very loud deep-toned bark. The stomachs of three specimens each contained a fresh-water crab. *Babina holsti* lives in the same situations, and when these two kinds of frogs were caught they were put into the same collecting bag. The result of this was that several specimens (as Nos. 22807, 22617, 22808) of *Rana namiyei* were badly wounded by the dagger-frogs. One was cut so deeply that much of the ovaries and small intestine protruded.

In life, the color above is olive bronze mottled with black, and beneath it is white mottled with brown. The front of arms, groin, inner surface of calves and the dorsum of the foot are golden brown. The pupil is garnet, rhomboidal, with long axis parallel to the mouth. The iris is golden-edged. From each angle of the pupil a dark band extends to the outer rim of the eye; the posterior is horizontal and broader, the anterior directed downward at forty-five degrees, the superior faintest. The upper half of the iris is tinged with bronze, the lower half is gray, and both show dark reticulations.

On May 8th, 1910, some eggs (No. 22675) were found in a little puddle by a brook, and from a crevice leading from this puddle one of the females was taken.

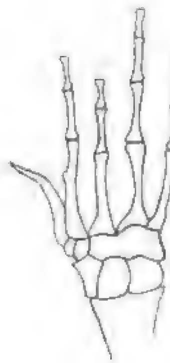
Babina Van Denburgh

Diagnosis.— Like *Rana,* but with a large, sheathed, bony spur on inner side of hand in the position of the metacarpal of pollex.

Type.—*Rana holsti* Boulenger.

Two large frogs from the Loo Choo Islands have been described as *Rana holsti* Boulenger and *Rana subaspera* Barbour. In the descriptions of both attention was called to the large development of the first metacarpal or rudimentary pollex. The abundant material in the present collection, and the field notes which accompany the specimens, indicate that this structure is so remarkable as to justify the placing of these frogs in a separate genus. What at first sight appears to be an innocent rudiment of a thumb is in reality a most formidable weapon.

Mounted upon the inner side of the carpus is a long, curved, sharply pointed bone, which seemingly is the first metacarpal. It is about equal in length to the other metacarpals. This bony spur is completely covered by the soft tissues about it. When, however, pressure is made upon the end of the "thumb," this sheath of soft tissue slips back and leaves the bony weapon



Bones of Right Hand of *Babina subaspera*

exposed and ready for use. When one of these frogs is caught, it strives to grasp a finger between its two hands, and when it succeeds—as the first one did—the spurs are driven into the finger down to the bone. Several specimens of *Rana namiyei* were badly slashed by some *B. holsti* that were put into the same bag. One received a clean-cut wound forty-five millimeters long in addition to several minor injuries. One can have only feelings of pity for any snake which might succeed in swallowing one of these dagger-frogs.

Both of these frogs have an unusual aggregation of glands above the insertion of the arm. It is probable that the secretion of these glands might often run down into wounds made by the spurs.

Babina holsti was found only on Okinawa, while *Babina subaspera* seems to be peculiar to Amami Ō shima.

Babina holsti (Boulenger)

Although described in 1892, *Babina holsti* has been known only from the unique type specimen, which was collected by Holst in Okinawa. We have now secured an excellent series of this remarkable frog from Nago, Okinawa.

The specimens agree very well with the original description of this frog, the principal point of discrepancy being that the interorbital space is constantly wider than the upper eyelid. As in *B. subaspera,* there normally is a large gland above the axilla. *B. holsti* is a very much smoother frog than *B. subaspera* and in it the dermal fold on the external edge of the metatarsus rarely extends more than one-third of the distance between the toes and the tarsus, while in *B. subaspera* it usually exceeds half this distance. Otherwise I am unable to find any structural differences between them. The general smoothness of one and wartiness of the other, however, render them readily distinguishable, except in a few instances.

The coloration of *B. holsti* is usually browner and darker than that of *B. subaspera,* and the dark markings—particularly the blackish band from the snout through the eye to the shoulder—are more distinct and definite.

In both frogs the fold from the eye to the shoulder may be very distinct, indistinct, or absent. The dorso-lateral fold may be broken up into a mere series of small glands hardly worthy of the term. The outer metatarsal tubercle usually is not developed, but in both forms it is sometimes present as a small rounded pad at the base of the fourth toe. The tibiotarsal joints may meet or not, but do not overlap; when turned forward they extend to the eye or between the eye and nostril. The tibia may be one-half the length of the head and body, but often is less. The web is not full, two terminal phalanges on the outer and one on the inner side of the fourth toe usually being free, except for the dermal margins. The vomerine teeth are between and extending behind the choanae. The diameter of the tympanum may be three times its distance from the orbit. There may or may not be a whitish pineal spot.

The white, pearl-like asperities vary very much in number in both frogs. Some specimens have very few anywhere. The chest may be entirely smooth. Others have them very numerous, so that they are crowded on the warts and over the chest and inner surface of the arms and first fingers. Sometimes they are scattered over the chin and upper surface of the head.

The coloration of a living specimen of *B. holsti* is described thus: The iris is golden above the level of the upper angle of the canthus, mahogany with black reticulations and golden sheen showing through below, rim golden. The pupil is black. Back uniform olive; sides olive brown with a few dark spots. A brown streak from tip of snout, through nostril and eye to temporal region. Lips dark brown with a golden stripe from nostril, below eye, under tympanum to above arm. The dorsolateral fold is olive like the back, but along its outer edge are a few black blotches. The limbs are brownish olive above, the arms spotted with blackish brown, and the hind limbs with three broad, light-edged bars. The throat is dark brown. The chest is lighter, with gray granules showing through. The belly is dirty white.

This frog was found only near Nago, Okinawa. The land east of Nago is very hilly with deep, shaded valleys in which are clear cool brooks, deeply shaded. In crevices of the rocks near the brooks, and in recesses near waterfalls, this frog and *Rana namiyei* were prevalent. Fifteen specimens were secured.

Babina subaspera (Barbour)

Rana subaspera was first described by Barbour, in 1908, from a single specimen "taken in the Riu Kiu Islands, May, 1904 by a Japanese collector of Mr. Alan Owston." Its exact place of origin has remained unknown. The collection now at hand contains some thirteen specimens of a large frog from Amami Ō shima which I believe is identical with Barbour's species. There are certain points of difference between my specimens and the original description of *R. subaspera,* but Mr. Barbour, at my request, has been so kind as to re-examine his type specimen—which seems not to be in perfect condition—and writes me that the apparent differences are not real. Thus his specimen agrees with mine in the width of the interorbital space, the webbing of the toes, the length of the tibia, etc.

As already stated under the heading *B. holsti,* this frog seems to be structurally like the preceding species in every respect except in the greater number of warts and the extent of the metatarsal fold. Nevertheless, the series of each at hand prove that we have to do with distinct species. *B. subaspera*

usually is lighter in coloration than *B. holsti;* and the dark markings, especially on the head and limbs, are less well-defined. In both species the dorso-lateral folds may be more or less broken up. *B. subaspera* may be very little (but is always) more warty than some specimens of *B. holsti,* or it may be so warty as to look almost like a toad. The tympanum sometimes is nearly hidden.

The bony spurs do not become firm enough for use until the frog is of considerable size. It was an adult of this species which astonished the collector by clasping his finger between its hands and driving the sharp spurs, one on each side, clear down to the bone. When the spurs are not in use they are completely covered by the skin.

Two had eaten fresh-water crabs, and one a land snail.

This frog was found only on Amami Ō shima. About five hundred meters west of the middle of the harbor, and at an altitude of about one hundred and fifty meters, there are a couple of paddy-fields. The water supply flows from springs that are very cold and come from many deep crevices. In these, *B. subaspera* holds forth at night with a prolonged, very loud, three-toned croak. Tadpoles were found in the paddy-fields along with *Diemictylus.*

Polypedates schlegelii Günther

This tree-frog was first described, in 1858, from Japanese specimens. Two years later Hallowell described his *Polypedates viridis* from a specimen taken on Loo Choo Island, (Okinawa). In 1907, Stejneger described specimens from Ishigaki shima under the name of *Polypedates owstoni,* and in 1908 Boulenger named the Formosan form *Rhacophorus moltrechti.* All these tree-frogs, which may be spoken of as the *Polypedates schlegelii* group, are very closely related.

The following remarks are based upon two specimens from Japan proper, fifteen from Amami Ō shima, forty-six from Okinawa, one-hundred and thirteen from Ishigaki, and nine from Formosa.

It may be said at once, that there appear to be no constant structural differences between any of these members of the *P. schlegelii* group. The two Japanese specimens have no outer

metatarsal tubercle. This tubercle is slightly developed in one specimen (No. 23753) from Okinawa. There appears to be no difference in the width of the dermal margin of the fingers. In all the members of the group the distance from the tip of the coccyx to the end of the sacral diapophysis is usually less than the width of the head, and greater than the distance from the tip of snout to center of tympanum; but it may be equal to that, or greater, in all except perhaps the Japanese, of which the series at hand is too small to show this variation. In specimens from all these localities the heel may reach the posterior border, the middle, or the anterior border of the eye. There seem to be no differences in the vomerine teeth, or the size of the tympanum, digital disks, or web. On the other hand, in both Japanese specimens, when the head is viewed from the side, the nostril appears to be very nearly midway between the eye and the end of the snout, while in a very large majority of the Loo Choo and Formosan examples the nostril is distinctly anterior to this point. When the legs are folded and held at right angles to the axis of the body, the heels do not meet in the specimens from Japan proper, whereas they do meet in 73.4% of the frogs from Amami Ō shima, 97.8% of those from Okinawa, 99.1% of those from Ishigaki shima, and 88.8% of those from Formosa.

As one passes from the north southward, the dark markings on the legs and sides of the body tend to lose the character of reticulations or cloudings (Japan and Amami Ō shima) and to become discrete dots (Okinawa), spots (Ishigaki), or blotches (Formosa). These dark markings usually are lacking in the young, and their character is not constant in the adult Loo Choo specimens, although it probably is in the adults from Formosa.

In view of these facts it seems best to retain in use the four names that have been proposed for these tree-frogs, but to regard *P. viridis* and *P. owstoni* as subspecies of *Polypedates schlegelii.*

The principal characters of *Polypedates schlegelii* may be expressed in the following:

Diagnosis.—Fingers nearly half webbed; heel without dermal appendage; vomerine teeth in two straight, but oblique,

series between, and starting close to, the choanae; tibio-tarsal articulation reaching eye; color above uniform green in life, with dark markings on the legs and sides of body, usually taking the form of reticulations or cloudings; tibio-tarsal joints not meeting when the folded legs are held at right angles to body axis; nostril usually midway between tip of snout and eye. Japan proper.

Polypedates schlegelii viridis (Hallowell)

Diagnosis.—Like *P. schlegelii* but with tibio-tarsal joints usually meeting when the folded legs are held at right angles to the body axis; nostril usually nearer to tip of snout than to eye; dark markings on thighs and sides of body either reticulations, cloudings, or very numerous small spots.

Amami O shima and Okinawa.

The tree-frogs of Amami O shima and of Okinawa seem not separable, although those from Okinawa show a greater average difference from true *P. schlegelii* than do those of Amami Ō shima. This subspecies has been partly discussed in considering the Japanese form.

No. 23845, an adult, has no vomerine teeth.

The specimens were collected at Naze, Amami Ō shima and at Nago and Naha, Okinawa, in April and May, 1910.

Polypedates schlegelii owstoni (Stejneger)

Diagnosis.—Similar to *P. schlegelii viridis* but with spots on thighs and sides of body discrete, larger, and less numerous. Ishigaki shima.

This form has been commented upon above under head of *P. schlegelii*. It is probable that the width of the head is greater than the distance from tip of a sacral diapophysis more constantly in this subspecies than in *P. schlegelii viridis* of the more northern islands; but since this relation is found in a majority of the northern specimens, it is of but little value in classification. The dark spots are absent in young specimens, and are subject to considerable variation in adult ones. Nevertheless the difference in the spotting of these two subspecies usually is quite characteristic.

In life, the lower surfaces may be either white, cream, or yellow. The groin may be gray, straw or tinged with salmon.

The thigh may be gray, yellowish green, yellow, or salmon. The color above may be yellow green. The young are sometimes grayish green.

The specimens are all from Ishigaki; no tree-frogs of this group have been taken on Miyako or Iriomote shima.

Polypedates moltrechti (Boulenger)

Diagnosis.—Similar to *P. schlegelii owstoni*, but with dark markings on thighs and sides of body much larger and still less numerous. Formosa.

This tree-frog is perhaps smaller when adult than its more northern relatives. The young are without dark markings. The seven adult specimens at hand agree in the characteristic blotching of the thighs and sides of body. Occasionally, these dark blotches are so large as to be confluent. As has been said in writing of *P. schlegelii*, there seem to be no structural differences between this and the other members of the group, but the constancy of the color-difference makes it desirable to regard the Formosan form as a distant species.

In life, the color above is light green; the tip of snout olive. The lower surfaces are cream. The inguinal region, anterior and posterior surfaces of thighs and legs, the top of foot and the web are pale salmon.

This tree-frog was originally secured at Lake Candidje, Nanto district, central Formosa. Its presence at Kosempo, Formosa, has since been recorded by its describer. Our specimens were collected at Kosempo and Kanshirei, Formosa.

Polypedates eiffingeri (Boettger)

This species was first described from a specimen from the Loo Choo Islands. Although the exact place of origin of the type was unknown, Dr. Boettger thought that it came either from Okinawa or Amami Ō shima; probably the former. We have received no specimens from either of these islands, but have three collected on Ishigaki between May 25 and June 2, 1910.

Dr. Boulenger has recorded the presence of this tree-frog at Kanshirei, Formosa, whence we have received a very large series. We have it also from Koshun, Formosa.

December 13, 1912.

The specimens at hand agree very well with the original description, and upon direct comparison there appears to be no difference between the Loo Choo and the Formosan examples. There is considerable individual variation in the large series from Kanshirei.

The skin of many specimens is perfectly smooth almost everywhere on the upper surfaces of the head, body, and limbs. In others it is dotted everywhere with little white warts or asperities. Some have these asperities only on the limbs and head, others only on the supraocular regions and sides of head. Every degree of intergradation is found between the smoothest and roughest specimens. The white dots on the feet and arms usually are raised on little warts, but may be level with the rest of the skin.

The vomerine teeth normally are in two rounded patches near the choanae; but in several specimens they are in transverse series very much as in *P. buergeri,* but never longer than the interval. A few specimens seem to have no vomerine teeth. In other specimens the teeth are intermediate between these three conditions. One has a single large clump near the median line and no lateral patches.

In alcoholic specimens, the color above may be uniform light bluish gray, yellowish or brownish gray, dark brown, or slate, with only a few small dark spots on the sides of the body; or there may be definite dark markings on the back. head, and limbs. There may be an X-shaped blotch between the shoulders, or only spots there and posteriorly, or nearly the whole back may be covered by one large dark blotch. Often there is a dark band across the head, passing over the upper eyelids. The limbs may be cross-barred. There is often, especially in large females, a bright purplish pink suffusion about the dark blotches in the upper surfaces, recalling the coloration of *Microhyla fissipes.* The lower surfaces may be white or yellow, immaculate or clouded, or sparsely or densely, spotted, marbled, or reticulated with dark brown. The rows of white dots along the foot and arm are almost always evident and are very characteristic.

One of the Ishigaki specimens, No. 23740, was colored in life as follows:—Iris bronze. Above light gray, a light green-

ish shading forming a V-shaped mark from top of eyelids backwards. A similar greenish tinge extends backward from the sacral region becoming brighter in the groin, where it shades off into dull yellow. Tympanum brownish with a darker line above. Hind limbs with three faint cross-bars. Throat white, abdomen cream. Between the colors of back and abdomen there are a few brown spots, increasing posteriorly to form considerable blotches, which are hidden when the limbs are folded in the sitting position. This is the bright coloration when on a whitish surface. When on a leaf, the green spreads to the sides and shoulders.

No. 23741, also from Ishigaki, in life was brown above with darker brown markings; yellowish below; groins straw.

No. 20087, from Kanshirei, Formosa, while living had the abdomen and sides white, thighs greenish straw, the light color of back and limbs light golden brown.

Polypedates japonicus (Hallowell)

Originally described from Amami Ō shima and since reported from Okinawa, this species is now at hand from Ishigaki and Iriomote, of the Loo Choo group. Boulenger has recorded its presence in Formosa and we have received a series from there. Our material comprises one hundred and seventy-eight specimens from Amami Ō shima, thirty-six from Nago, Okinawa, sixty-eight from Ishigaki, seven from Iriomote, and seven from Formosa. Curiously enough this tree-frog was not found in Miyako shima.

Careful comparison of this enormous material has failed to develop any differences between the specimens from the various islands of the Loo Choo group. They seem to be quite alike in structure, proportions and coloration. The Formosan specimens lack the definite dark patch or streak on or above the tympanum, having at most a mere trace of it, although it is present in all the Loo Choo specimens. In other respects these Formosan examples are indistinguishable from the Loo Choo frogs, and this difference seems too slight to justify their recognition as a distinct subspecies.

Polypedates robustus (Boulenger)

We have received one specimen of this tree-frog (No. 25043) from Koshun, Formosa. It is so like *P. buergeri* of Japan that the greater extent of the web between the fingers seems to be the only constant difference.

Boulenger's specimens were from Kankau, Alikang, and Kosempo, Formosa.

Polypedates leucomystax (Gravenhorst)

Only one Formosan specimen of this tree-frog has been recorded, and this one bears no statement of more definite locality. We have received four specimens from Kanshirei and one from Koshun, Formosa. Both striped and unstriped styles of coloration are shown. In these Formosan examples the vomerine teeth are nearer the choanae, and the dark reticulation on the backs of the thighs is much coarser than in Philippine specimens. The general proportions are quite the same. Nevertheless, when larger series are at hand, it may become necessary to regard the Formosan frogs as a distinct subspecies differing from the Philippine in having vomerine teeth nearer the choanae, toes a little less extensively webbed, metatarsal tubercle somewhat larger, and thigh markings coarser.

Gekko japonicus (Duméril & Bibron)

This species differs from *G. swinhonis* in the possession of a distinct interdigital web, more numerous dorsal tubercles and fewer enlarged tubercles near the ear.

We have one specimen labeled Eastern Asia, three from Shanghai, eleven from Formosa, two from Ishigaki, thirteen from Naha, Okinawa, twenty-eight from Naze, Amami Ō shima, and a few from Japan proper. The Formosan specimens are from Koshun, Kanshirei and Taihoku.

In this considerable series there appears but little variation. The Loo Choo specimens often have smaller chinshields than the Formosan, and the latter tend to have fewer plates under the fourth toe than the Shanghai specimens. These differences, however, are neither constant nor great enough to warrant the recognition of separate subspecies.

Gekko swinhonis (Günther)

We have five specimens collected by Dr. Thompson at Chefoo, China, August 19 to 29, 1906. These are entirely without webs between the digits, and their enlarged dorsal tubercles are very few, and the tubercles near the ear many, as compared with specimens of *Gekko japonicus* from Shanghai, Formosa, and the Loo Choo Islands. There appears to be no constant difference in the chin-shields.

Hemidactylus frenatus Duméril & Bibron

The collection contains twenty-three specimens of this gecko from Formosa, where they were collected at Tainan, Kohekiryo, Kanshirei, Takao, Anping, Polisia, Koshun, and Ako. From the Loo Choo Islands we have received six from Okinawa, three from Miyako and seventy-four from Ishigaki. It therefore appears that this species is much more common than *H. bowringii.* We have also twelve specimens from the Pescadores, where they were found under stones on barren hill-sides.

Careful comparison has failed to bring to light any differences in the specimens from these various localities.

Hemidactylus bowringii (Gray)

We have received one male (21854) from Miyako, one male (21856) and one female (21855) from Ishigaki, and four males from the following localities in Formosa: 18066 Kanshirei, 18078 Taipeh, 18079 Taihoku, and 18080 Nanto.

There seem to be no important differences between these specimens. They may be readily distinguished from *H. frenatus* by the nearly uniform dorsal granulation, longer terminal portion of the inner digit, and the median interruption of the series of pores in the males.

Hemidactylus marmoratus Hallowell

We have received no specimen which agrees with Hallowell's description of *H. marmoratus* although we have one hundred and fifty specimens of various species of *Gekkonidae*

from the Loo Choo Islands. Stejneger's suggestion that Dr. Hallowell may have had a poorly preserved specimen of *Gekko japonicus* probably is correct.

Cosymobotus platyurus (Schneider)

The present collections contain no specimens of this gecko, which has been credited to Formosa on the evidence of a single specimen in the Bergen Museum, said to have been collected by Captain von der Ohe in the early sixties.

Ptychozoon horsfieldii (Gray)

Regarding this lizard Dr. Stejneger writes (Bull. U. S. Nat. Mus. No. 58, p. 172),

"This remarkable species is an inhabitant of the Malayan Peninsula, the Natuna Islands, and Borneo.

"A single specimen presented by Mr. Pryer to the British Museum as having been obtained by his Japanese collector in the Riu Kiu [Loo Choo] Islands, is the only one thus far recorded east and north of the region indicated above. As no other collectors have found it in the Riu Kius or the intervening regions, I may perhaps be justified in expressing a doubt as to the correctness of the locality. It may be remembered that Pryer himself did some collecting in Borneo in 1880, and it is possible that the specimen in question may have become mixed up with the Riu Kiu collection."

The large collections now at hand from the Loo Choo Islands and Formosa contain no specimens of this lizard. There can be little doubt that it does not occur in these islands.

Japalura swinhonis Günther

We have received Japaluras from Kagi, Kosempo, Nanto, Tainan, Jenshiko and Kanshirei, Formosa. These all seem to represent but one species. This species has keeled infralabials, while the Japaluras of the Loo Choo Islands have smooth infralabials. This character holds in more than 98% of the large series at hand, so we are justified in regarding the Formosan and Loo Choo lizards as distinct species.

In a few specimens the throat is nearly unicolor; in a considerable number it is light with converging dark lines; but in most it is dark with light spots or streaks.

Japalura swinhonis mitsukurii (Stejneger)

I am unable to find any constant point of difference between specimens of *Japalura* from Botel Tobago, and from Formosa. The differences in proportions which have been suggested as distinguishing characters do not hold good. In the Botel Tobago lizards the width at the superciliaries is constantly less than the length of the third toe, but the same proportions are to be found in a number of Formosan specimens. Still a majority from the latter locality have the superciliary width greater than the length of the third toe without claw. The number of specimens from Botel Tobago is too small, to enable us to reach any very satisfactory conclusion, and for the present it seems best to regard the Botel Tobago specimens as a doubtful subspecies.

Japalura polygonata (Hallowell)

We have examined one hundred and nineteen specimens from Naze, Amami Ō shima, fifteen from Nago and Naha, Okinawa, eight from Miyako, eight from Ishigaki, and sixteen from Funaoke, Iriomote. One hundred and forty-eight of these have no keeling of the infralabials, while a weak keel may be made out in one specimen from Ishigaki and two from Iriomote. Thus in 98% of the Loo Choo specimens the infralabials are smooth, while in 98.6% of the Formosan examples they are keeled. These Loo Choo lizards have a definite, though not continuous, row of enlarged scales on the back, separated from the crest row by about two or three rows of smaller scales. In the Formosan species no definite row of this description is to be found, the scales near the dorsal row being more nearly equal in size. The throat in Loo Choo specimens usually is light unicolor or, less frequently, with narrow, dark, converging lines. The Formosan and Botel Tobago specimens have dark throats with whitish markings showing either as spots or as transverse bands.

Specimens from the southern islands—Ishigaki and Iriomote—nearly always have a distinct whitish band under the eye. Those from Miyako and the more northern islands usually lack this light band. Thus this band is present in eight from Ishigaki and in sixteen from Iriomote; is absent from eight from Miyako, thirteen out of fifteen from Okinawa, and ninety-two out of one hundred and nineteen from Amami Ō shima.

Specimens from Iriomote, Ishigaki, and Miyako usually show a distinct light streak along each side of the body, as do most of the Formosan and Botel Tobago Japaluras. This streak usually is absent in specimens from Okinawa and Amami. This is shown in the following table:

LIGHT STREAK	Distinct	Slight	Absent
Botel Tobago	2		2
Formosa	77	10	17
Iriomote	11		5
Ishigaki	4	1	3
Miyako	6		2
Okinawa		2	13
Amami		47	72

These data may be arranged in the form of a key, as follows:

a.—Infralabials keeled; throat usually dark with whitish markings.
  b.—Width at superciliaries usually greater than length of third toe without claw. Formosa.
    Japalura polygonata.
  b².—Width at superciliaries not greater than length of third toe without claw. Botel Tobago.
    Japalura polygonata mitsukuri.
a².—Infralabials smooth; throat light, unicolor or with narrow dark lines.
  bb.—A very distinct whitish band under eye; usually a lateral light band. Ishigaki and Iriomote.
    Japalura polygonata ishigakiensis.
  bb².—No distinct whitish band under eye.
    c.—Usually a distinct lateral light streak. Miyako.
      Japalura polygonata miyakensis.
    c².—Lateral light streak absent or but slightly developed. Okinawa and Amami.
      Japalura polygonata polygonata.

The three forms from the Loo Choo Islands seem worthy of rank as subspecies. Since *Japalura polygonata* was originally established from specimens from one of the northern islands, we may regard the lizards of Okinawa and Amami as the typical form, and may name the other two as follows:

Japalura polygonata miyakensis Van Denburgh

Diagnosis.—Infralabials smooth; throat light, unicolor or with narrow dark lines; no distinct whitish band under eye; a distinct lateral light streak usually present.

Type.—California Academy of Sciences No. 21,353, **Miyako, Loo Choo Islands, Japan.**

Distribution.—Miyako shima, Loo Choo Islands, Japan.

Japalura polygonata ishigakiensis Van Denburgh

Diagnosis.—Infralabials smooth; throat light, unicolor or with narrow dark lines; a very distinct whitish band under eye; a lateral light streak usually present.

Type.—California Academy of Sciences No. 21,354, **Ishigaki, Loo Choo Islands, Japan.**

Distribution.—Iriomote and Ishigaki, Loo Choo Islands, Japan.

Eumeces

There are in China two very distinct species of the genus *Eumeces*. The one characterized by the possession of but one unpaired postmental is *E. elegans*. The other, which normally has two azygous postmentals, is *E. chinensis*. The former is represented in Japan, the Loo Choo Islands, the Pescadores and Formosa by a number of species and subspecies which may be spoken of as the *Eumeces elegans* group. The latter, *E. chinensis,* seems to have no representatives in Japan and the northern and central islands of the Loo Choo archipelago, but has close relatives in the southern islands and in Formosa. The Formosan specimens have been regarded as identical with the mainland examples of *E. chinensis*. The specimens from Miyako, Ishigaki and Iriomote have been described as *E. kishinouyei*.

The members of the *E. chinensis* group seem everywhere to be less numerous than those of the *E. elegans* group. We have received only one specimen from China, four from Formosa, and seven from the southern islands. This material is too limited to give really satisfactory results, but it seems to indicate that both the Loo Choo and the Formosan lizards should be regarded as distinct subspecies. The chief differences are indicated in the Key given below.

The *E. elegans* group is to be regarded as made up of three subgroups, as follows:—

1. The *Eumeces elegans* subgroup, characterized by the presence of a patch of much enlarged scales on the back of the thigh and the absence of a postnasal plate, and including only *E. elegans.*

2. The *Eumeces latiscutatus* subgroup, characterized by the absence of a patch of enlarged scales on the back of the thigh and the presence of a postnasal plate, and comprising *E. latiscutatus, E. latiscutatus okadae,* and *E. barbouri.*

3. The *Eumeces marginatus* subgroup, characterized by the absence of a patch of much enlarged scales on the back of the thigh and the absence of a postnasal plate, and made up of *Eumeces marginatus, E. marginatus kikaigensis, E. marginatus amamiensis,* and *E. ishigakiensis.*

The chief differences between these various forms are indicated in the following

KEY TO THE SPECIES AND SUBSPECIES.

a.—Only one azygous postmental; a strongly keeled scale behind corner of anus.

b.—A patch of much enlarged scales on back of thigh. No postnasal. (China, Formosa, Pescadores).

Eumeces elegans.

b².—No patch of much enlarged scales on back of thigh (sometimes slightly enlarged in *E. marginatus* subgroup).

c.—No postnasal. (Loo Choo Islands).

d.—Young with two lateral lines separated by about the width of two scales; lower lateral line separated from fore-limb by not more than distance between lateral lines.

e.—Scales of two middle dorsal rows broader than those of next rows; upper lateral line confined to scales of third row from middorsal line; superciliaries not more than eight. (Okinawa).

E. marginatus.

e².—Scales of two middle dorsal rows normally not broader than those of next rows; upper lateral line on scales of third and fourth rows from middorsal line; superciliaries not less than eight.

f.—Normally with twenty-six rows of scales around middle of body. (Amami Ō shima).

E. marginatus amamiensis.

f².—Usually with twenty-eight rows of scales around middle of body. (Kikaiga shima).

E. marginatus kikaigensis.

d².—Young with three lateral lines; upper two separated by about the width of one scale; second lateral line, from above, separated from fore limb by more than distance between upper and second lateral lines. (Ishigaki shima).

E. ishigakiensis.

c².—A postnasal present. (Japan proper and Amami Ō shima).

dd.—Scales around middle of body not less than twenty-four. (Japan proper).

ee.—Scales around body normally twenty-six or twenty-four (rarely 28). (Japan).

E. latiscutatus.

ee².—Scales around body normally twenty-eight or thirty. (Idzu Seven Islands).

E. latiscutatus okadae.

dd².—Scales around middle of body twenty-two (Amami Ō shima).

E. barbouri.

a².—Azygous postmentals normally two; no keeled scale behind corner of vent.

bb.—No postnasal; two pairs of nuchals; median dorsal line in young broader. Fifty-four dorsals from parietals to backs of thighs, fourteen scutes under fourth toe. (China).

E. chinensis.

bb².—Postnasal often present; often three nuchals; median dorsal line in young narrower.

ccc.—Forty-eight to fifty-two dorsals from parietals to backs of thighs; fourteen to sixteen scutes under fourth toe; interparietal about twice as long as broad; dorsal and lateral scales spotted or edged with black or dark brown except in position of dorso-lateral light lines of young.

E. chinensis formosensis.

ccc².—Forty-five to forty-nine dorsals from parietals to backs of thighs; sixteen or seventeen scutes under fourth toe; interparietal much less than twice as long as broad; nearly unicolor or with dark-edged light lines, often dark lateral band.

E. kishinouyei.

Eumeces latiscutatus (Hallowell)

Diagnosis.—One azygous postmental; no patch of enlarged scales on back of thigh; postnasal normally present (rarely absent); posterior loreal short, normally touching two labials; fifteen to eighteen scales under fourth toe; twenty-six (rarely twenty-four or twenty-eight) scales around middle of body; forty-nine to fifty-five on back; young with one median and two lateral light lines; latter narrow, and separated by not less than width of two scales; lower lateral line separated from fore limb by less than distance between lateral lines, and running below the level of top of hind limb and top of ear.

This species is confined to the large islands which constitute Japan proper. We have at hand only eight specimens. Three are from Kobe, Setsu Province, Hondo, the others were secured near Kagoshima, Satsuma Province, Kiusiu.

Six have scales in twenty-six rows, one has twenty-four, and one twenty-seven; the scales between the parietals and a line joining the backs of the thighs vary from forty-nine to fifty-five, and the plates under the fourth toe vary from fifteen to eighteen. The frontal touches the frontonasal in only one specimen, but is in contact with three supraoculars in all. All have one postnasal on each side, and one azygous postmental. There usually is but one pair of nuchals, but two specimens have two additional small plates on one side. The posterior loreals are short and in contact with only two labials, except in two specimens in which they are longer and touch 2-3 and 3-3 labials. There is no patch of enlarged scales on the back of the thigh in any of these Japanese lizards.

Eumeces latiscutatus okadae Stejneger

Diagnosis.—One azygous postmental; no patch of enlarged scales on back of thigh; postnasal present; posterior loreal short, normally touching two labials; about eighteen scutes under fourth toe; one or two pairs of nuchals; twenty-eight or thirty scales around middle of body.

We have received in exchange from the U. S. National Museum one of the original specimens (U. S. N. M. No. 36531) described by Dr. Stejneger. This specimen, which was collected by Okada in Nii shima, Idzu, is now number 27,229 of the Academy's collection. It has twenty-eight scales around the body, fifty-four between the parietals and the backs of the thighs, eighteen under the fourth toe, seven supralabials, and one and three nuchals. The frontal is in contact with three supraoculars and the frontonasal. The posterior loreals are short, and touch only two labials each. There is one postnasal on each side. There is no patch of enlarged scales on the back of the thigh.

Eumeces barbouri Van Denburgh

Diagnosis.—One azygous postmental; no patch of enlarged scales on back of thigh; postnasal present; posterior loreal short, normally touching two labials; fifteen or sixteen plates under fourth toe; twenty-two scales around middle of body; young with one median and two lateral light lines; latter narrow, and separated by not less than width of two scales; lower lateral line separated from fore limb by less than the distance between the lateral lines, and running below the level of top of hind limb and top of ear.

Type.—California Academy of Sciences No. 21545. **Amami Ō shima, Loo Choo Islands, Japan**; April 20-30, 1910.

Description of the type.—Similar to *E. latiscutatus.* Nasal small, in contact with rostral, supranasal, postnasal, and first labial plates. Anterior loreal forming sutures with postnasal, supranasal, prefrontal, posterior loreal, and second labial plates. Posterior loreal longer than high, in contact with two (right) or three (left) labials. First labial in contact with rostral, nasal, postnasal, and second labial. Frontal just separated from frontonasal, in contact with three supraoculars on each side. Parietals large, separated by interparietal. One left and two right nuchals. Upper temporal largest. Seven supralabials, the seventh largest. One azygous postmental. Scales smooth, except one behind each corner of vent; twenty-two around middle of body; fifty in a row from parietals to line joining backs of thighs; two middorsal rows slightly enlarged. Median subcaudal row broad. No patch of enlarged scales on back of thigh. Fifteen or sixteen scutes under fourth toe. Hind limb reaching between wrist and elbow. Tail forked at point of regrowth.

The color above is nearly uniform light brown, with a few dark brown spots at the bases of the scales posteriorly. A dark brown band extends from the temporal region to the base of the tail, and is edged above and below with lighter brown indications of the lateral light lines. The upper lateral and middorsal lines are evident on the tail. The limbs are brown, the centers of the scales being lighter. The lower surfaces are greenish white, clearer yellowish white on the chin, preanals and midcaudals.

A young specimen is black above with two narrow lateral pale blue lines on each side, and a broader middorsal line which bifurcates on the head as in other species of the group. The tail is very bright blue.

Length to anus	66	49 mm.
Length of tail		90 "
Snout to ear	13	10 "
Snout to fore limb	22	28 "
Fore limb	19	15 "
Hind limb	28	22 "
Base of fifth to end of fourth toe	12	10 "

Variation.—The smaller specimen differs from the type in having the frontal in contact with the frontonasal, the second loreal touching only two labials on each side, the superposition

of the first loreal, the presence of two nuchals on each side, and sixteen plates under each fourth toe. The scale counts around the body and along the back are twenty-two and fifty.

Distribution.—This lizard was found only on Amami Ō shima.

Remarks.—This lizard must be rather rare; for of eighty-one specimens of this genus taken on Amami Ō shima only two are of this species, the others being *Eumeces marginatus*. *Eumeces barbouri* is practically a *Eumeces latiscutatus* with the scales around the middle of the body reduced in number to twenty-two.

The presence in the Loo Choo Islands of a close relative of *Eumeces latiscutatus* is one of the most interesting facts brought out by these collections, since it affords, as I believe, the first definite evidence of a former land-connection between these islands and Japan proper.

It is a pleasure to name this lizard in honor of Mr. Thomas Barbour of Harvard University.

Eumeces marginatus (Hallowell)

Diagnosis.—One azygous postmental; no patch of much enlarged scales on back of thigh; no postnasal; posterior loreal long, usually in contact with three supralabials; sixteen to twenty plates under fourth toe; twenty-six (rarely twenty-eight) scales around middle of body; young with one median and two lateral light lines, the latter narrow and separated by not less than width of two scales, lower lateral line separated from forelimb by less than distance between lateral lines, and running at about the level of top of hind limb but below top of ear; scales of first row on each side of middorsal line wider than those of next dorsal rows; superciliaries not more than eight; upper lateral line narrow, confined to scales of third row from middorsal line.

Variation.—We have received only eleven specimens of the *Eumeces* of Okinawa. All have one azygous postmental, no postnasals, upper temporal largest, frontal in contact with frontonasal and with three supraoculars of each side, seven supralabials, and posterior loreals much longer than high. Both posterior loreals touch three labials except in No. 21641,

in which they are in contact with only two. One specimen has but one pair of nuchals, one has one and three; the others all have three pairs, of which the first are much the largest. The scales around the middle of the body are twenty-six except in one specimen, which has twenty-eight. The scales in a row from the parietals to a line joining the backs of the thighs vary in number from fifty to fifty-seven:—fifty in one specimen, fifty-one in one, fifty-three in five, fifty-four in two, fifty-five in one, and fifty-seven in one. The scales under the fourth toe are sixteen in one specimen, seventeen in one, eighteen in three, nineteen in four, and twenty in two. The superciliaries are eight or seven. The greater breadth of the middorsal rows is nearly constant, being clearly shown by all but one specimen.

Distribution.—Typical *Eumeces marginatus* seems to be confined to Okinawa shima, where it has been taken at Naha and Nago.

Remarks.—This lizard of Okinawa is closely related to the subspecies of Amami Ō shima and Kikaigo shima, and less closely to *Eumeces ishigakiensis.* It differs from all these in coloration and in the breadth of the upper rows of dorsal scales.

When Hallowell wrote the original description of this species he had specimens from both Amami Ō shima and Okinawa shima. ("Ousima, Japan, and Loo Choo Islands"). There is nothing to indicate either as the type. Stejneger has since stated that the Okinawa specimen should be regarded as the type, the Amami Ō shima example having been lost. It therefore seems best to regard the Okinawa lizard as the typical *Eumeces marginatus.*

Eumeces marginatus amaniensis Van Denburgh

Diagnosis.—One azygous postmental; no patch of much enlarged scales on back of thigh; no postnasal; posterior loreal long, usually in contact with three supralabials; seventeen to twenty-one plates under fourth toe; twenty-six (rarely twenty-four or twenty-eight) scales around middle of body; young with one median and two lateral light lines, latter broader but separated by not less than width of two scales, lower lateral line

separated from forelimb by less than distance between lateral lines, and running at about the level of top of hind limb but below top of ear; scales of first row on each side of middorsal line very rarely wider than those of next dorsal rows; superciliaries not less than eight; upper lateral line broader, on scales of third and fourth rows, from middorsal line.

Type.—California Academy of Sciences No. 21615. **Amami Ō shima, Loo Choo Islands, Japan**; April 26 to May 1, 1910.

Description of the type.—Nasal small, in contact with rostral, supranasal, anterior loreal, and first labial plates. Anterior loreal forming sutures with nasal, supranasal, frontonasal, prefrontal, posterior loreal, and first and second labial plates. Posterior loreal longer than high, in contact with two (left) or three (right) labials. First labial in contact with rostral, nasal, anterior loreal and second labial. Frontal not separated from frontonasal, in contact with three supraoculars on each side. Parietals large, separated by interparietal. Three nuchals. Upper temporal largest. Seven supralabials, the seventh largest. One azygous postmental. Scales smooth, except one behind each corner of vent; twenty-six around middle of body; fifty-four in a row from parietals to line joining backs of thighs; middorsal rows not appreciably enlarged. Median subcaudal row broad. No patch of much enlarged scales on back of thigh. Seventeen to twenty-one scutes under fourth toe. Hind limb reaching wrist.

The color above is nearly uniform light brown, more yellowish on the head and tail. A brick-red band runs from the temporal regions along the side of the neck and body. The lower surfaces are greenish or yellowish white.

Length to anus	85	mm.
Length of tail	116	"
Snout to ear-opening	19	"
Snout to fore limb	28	"
Fore limb	23	"
Hind limb	33	"
Base of fifth to end of fourth toe	13	"

Variation.—Of seventy-nine specimens at hand, all have one postmental, no postnasals, and upper temporal largest. The frontal is in contact with the frontonasal in all but two, in one of which a small plate intervenes. In two the frontonasal is divided. No. 21566 has the second and third left supraoculars merged. The posterior loreal is much longer than high in all but four, and touches three labials on both sides of the head in all but ten specimens, of which eight have the loreal of one side touching three labials, while only two have both posterior loreals in contact with only two labials. The scales around the middle of the body are twenty-six in all but three specimens; Nos. 21572 and 21580 have twenty-four and No. 21576

has twenty-eight. The frontal touches three supraoculars on each side except in three cases, where it is in contact with only two on one side of the head. In twenty-five specimens the plates under the fourth toe are 17 in one, 18 in three, 19 in thirteen, 20 in seven, 21 in one. The scales in a row from the parietals to a line joining backs of thighs vary from fifty-three to fifty-six:—53 in 5 specimens, 54 in 6, 55 in 13 and 56 in 1. The supralabials are 6-7 in 3 specimens, 7-8 in 2 and 7-7 in 20. A few specimens have the upper dorsal rows slightly enlarged, and a few have somewhat enlarged scales on back of thigh, but never as in *E. elegans*. The young have five light lines and blue tails.

Distribution.—This subspecies is known only from Amami Ō shima, Loo Choo Islands, Japan.

Remarks.—*Eumeces marginatus amamiensis* is most closely related to *E. m. kikaigensis,* from which it differs as indicated under that head. From *E. marginatus* of Okinawa it differs in the fact that the middorsals normally are not wider than those of the other rows, in the increased number of superciliaries, which normally are nine or ten, instead of eight, and in the breadth and position of the upper lateral line, which difference seems to be quite constant.

Eumeces marginatus kikaigensis Van Denburgh

Diagnosis.—One azygous postmental; no patch of much enlarged scales on back of thigh; no postnasal; posterior loreal usually long, usually in contact with three supralabials; sixteen to twenty-one plates under fourth toe; usually twenty-eight (sometimes twenty-six) scales around middle of body; young with one median and two lateral light lines, the latter narrow and separated by not less than the width of two scales, lower lateral line separated from fore limb by less than the distance between the lateral lines, and running at about the level of top of hind limb but below top of ear; scales of first row on each side of middorsal line usually not appreciably wider than those of next dorsal rows; superciliaries not less than eight; upper lateral line broader, on scales of third and fourth rows from middorsal line.

December 13, 1912.

Type.—California Academy of Sciences No. 21628. **Kikaiga shima, Loo Choo Islands,** April 30, 1910.

Description of the type.—Nasal small, in contact with rostral, supranasal, anterior loreal, and first labial plates. Anterior loreal forming sutures with supranasal, frontonasal, prefrontal, posterior loreal, and first and second labials. Posterior loreal longer than high, in contact with three labials. Frontal in contact with frontonasal and first to third supraoculars. Parietals large, separated by interparietal. Three pairs of nuchals, first largest. Upper temporal largest. Seven supralabials, seventh largest. One azygous postmental. Scales smooth except one behind each corner of vent; twenty-eight around middle of body; fifty-five in a row from parietal to a line joining backs of thighs; middorsal rows not enlarged. Median subcaudal row broad. No patch of much enlarged scales on back of thigh. Nineteen scutes under fourth toe. Hind limb reaching elbow.

The color above is uniform light yellowish brown. A brick-red band runs across the temporal region and the sides of neck and body. Another red band extends from the seventh labial to the fore limb, and faintly along the side of the body. The lower surfaces are greenish white, clearer yellowish white on the chin, throat, preanal region, and tail.

Length to anus	73 mm.
Length of tail	93 "
Snout to ear-opening	16 "
Snout to forelmb	25 "
Fore limb	20 "
Hind limb	30 "
Base of fifth to end of fourth toe	12 "

Variation.—We have twenty-two specimens. All have one postmental, no postnasals, upper temporal largest, and frontal in contact with three supraoculars and the frontonasal. The supralabials are 7-7 in all but three, which have 7-8. One specimen has a single pair of nuchals; one has two on one side and three on the other; the others all have three pairs, the first pair being much larger. The posterior loreal touches three labials on both sides in ten, two on one side and three on the other in seven, and two on both sides in five specimens. The scales around the middle of the body are twenty-eight in thirteen specimens, twenty-seven in two, and twenty-six in seven. The number of scales in a row from the parietals to a line joining the backs of thighs varies from fifty-three to fifty-eight:—53 in 2 specimens, 54 in 5, 55 in 10, 56 in 2, 57 in 2, and 58 in 1. The number of plates under the fourth toe is 16-18 in 1 specimen, 17 in 2, 18 in 4, 19 in 11, 20 in 3, and 21 in 1. A few specimens have a few slightly enlarged scales on the back of the thigh. The young have five light lines and blue tails.

Distribution.—This subspecies is confined to Kikaiga shima, the easternmost island of the Loo Choo group.

Remarks.—*Eumeces marginatus kikaigensis* is most nearly related to *E. m. amamiensis*. This is what one should expect from the relative positions which their islands occupy. It differs from the Amami subspecies chiefly in the increased number of scales. The snout is probably a little longer, and the posterior loreal is more frequently in contact with only two labials. It differs from the Okinawa form just as *E. m. amamiensis* does, and also in the increased number of scales.

Eumeces ishigakiensis Van Denburgh

Diagnosis.—One azygous postmental; no patch of much enlarged scales on back of thigh; no postnasal; posterior loreal usually rather short, touching either two or three labials; seventeen to twenty-one plates under fourth toe; twenty-six (rarely twenty-four or twenty-eight) scales around middle of body; young with one median and three lateral light lines; latter narrow, and upper two separated by less than width of two scales; middle lateral line separated from fore limb by not less than the distance between the lateral lines, and running above the level of top of hind limb and at level of top of ear.

Type.—California Academy of Sciences No. 21666. **Ishigaki shima, Loo Choo Islands, Japan**; May 25-June 2, 1910.

Description of the type.—Similar to *E. marginatus*, but with an extra pair of lateral light lines. Nasal small, in contact with rostral, supranasal, and first labial plates. Anterior loreal forming sutures with nasal, supranasal, frontonasal, prefrontal, posterior loreal, and first and second labial plates. Posterior loreal little longer than high, in contact with two labials. First labial in contact with rostral, nasal, anterior loreal, and second labial. Frontal in contact with frontonasal, and with three supraoculars on each side. Parietals large, separated by interparietal. Three pairs of rather small nuchals. Upper temporal largest. Seven supralabials, the seventh largest. One azygous postmental. Scales smooth, except one behind each corner of vent; twenty-six around middle of body; fifty-four in a row from parietals to line joining backs of thighs; two middorsal rows not enlarged. Median subcaudal row broad. A patch of slightly enlarged scales on back of thigh. Twenty scutes under fourth toe. Hind limb reaching between wrist and elbow.

The color above is dark brown, lighter on the head, and at the edges of the dorsal, and centers of the lateral and limb scales. A light line extends along the middorsal line of body and basal half of tail, bifurcating at the parietals as in the other members of the group. An upper lateral line starts on the superciliaries and extends to the middle of the tail, being

separated from the middorsal line on the body by about the width of two scales. A second labial line arises on the seventh labial, runs to the upper end of the ear-opening, and extends to the base, or less definitely to the middle, of the tail, passing above the hind limb, and being separated from the fore limb by not less than the distance between the upper and the second lateral lines. This second lateral line is separated from the upper lateral line by only the width of one scale. A third lateral line originates near the lower part of the ear-opening, passes just above the fore limb, and extends to about the middle of the thigh. The tail is bright blue. The lower surfaces are grayish white, clearer on the chin, the gular and preanal regions, and the limbs.

Length to anus	57	mm.
Length of tail	82	"
Snout to ear	11	"
Snout to fore limb	19	"
Fore limb	15	"
Hind limb	22	"
Base of fifth to end of fourth toe	9	"

Variation.—Thirty-three specimens are at hand. A few of these have a small group of slightly enlarged scales on the back of the thigh, most have none, and none show any such enlargement as is always found in *E. elegans*. All have one postmental. None has a postnasal. The frontal is in contact with three supraoculars in all, except that in No. 21645 it touches only two on one side of the head. In No. 21663 the third left supraocular is divided. The frontal meets the frontonasal in twenty-four, and is separated in nine specimens. The posterior loreal is not much longer than high in twenty-three; it touches 2-2 labials in eleven specimens, 2-3 in eleven, and 3-3 in eleven. The upper temporal is largest. The scales around the body are twenty-six in twenty-eight specimens, twenty-four in three, and twenty-eight in two. In twenty-five specimens examined for the following characters, the scales under the fourth toe vary from seventeen to twenty-one, being 17 in 1 specimen, 18 in 9, 19 in 8, 20 in 5, and 21 in 2. The scales in a row from parietals to a line joining backs of thighs vary from fifty-one to fifty-five:—51 in 4 specimens, 52 in 6, 53 in 6, 54 in 7, 55 in 2. The supralabials are 7-7 in all except No. 21647, which has 6-7.

The youngest specimens all show the three lateral lines. In many of the somewhat larger examples the lower line becomes faint or disappears. Such specimens have two lateral lines, but may readily be distinguished from *E. marginatus* by the position of the lower line. In still larger specimens the

middorsal line becomes paler and disappears. In the largest specimens (snout to anus 64 mm.) the lateral lines have nearly or quite disappeared, and the temporal regions and sides of the body and neck are suffused with brick-red. The ground color is black in the smallest specimens, but becomes gradually paler until, in the largest, it is a light grayish brown.

Distribution.—This seven-lined skink has been found only on Ishigaki shima, where it evidently replaces *E. marginatus* of the northern Loo Choo Islands.

Remarks.—This species evidently is closely related to *E. marginatus.* It differs in the coloration and in the shape and relations of the posterior loreal. From *E. elegans* it may be readily distinguished by the coloration and the absence of the patch of much enlarged scales on the back of the thigh.

Eumeces elegans Boulenger

Diagnosis.—One azygous postmental; a patch of much enlarged scales on back of thigh; no postnasal; posterior loreal short, normally touching two labials; eighteen to twenty-two scutes under fourth toe; twenty-six or twenty-eight scales around middle of body; fifty-three to fifty-five scales from parietal to back of thighs; young with one median and two lateral light lines; latter narrow, and separated by not less than width of two scales; lower lateral line separated from fore limb by less than distance between the lateral lines, and running at level of top of hind limb and usually below top of ear.

Five specimens are at hand from an altitude of 1000 to 1500 feet in Mohkanshan, near Huchou, Chekiang, China, not far from Ningpo, the type locality. These specimens all have twenty-eight scales around the middle of the body, seven supralabials, one azygous postmental, no postnasal, three pairs of nuchals, of which two usually are much smaller, and upper temporal much larger than lower. The posterior loreal touches three labials on one side of the head in one specimen, and two in all others. The frontal is in contact with the frontonasal in two, separated in three. This plate touches three supra-

oculars in all except one specimen, in which it meets only two on each side. The scales under the fourth toe are 18, 18, 18, 22, 22; and those on the back from the parietals to a line joining the backs of the thighs are 53, 54, 55, 55, 55.

Since the scale counts are so constant in this series, while Boulenger reports twenty-six rows in his specimens, there can be little doubt that more than one form of this lizard occurs in China.

In addition to these specimens from China we have fifteen from the Pescadores, nine from Koshun, Formosa, and twenty-eight from Maru Yuma, Keelung, San Shi Ka, Taipeh, and Tainan, Formosa. These three sets of specimens show certain tendencies toward differentiation one from another, but these differences are so intangible that it seems best to use but one name for all these and also for the Chinese specimens until the mainland forms are better known. At first, it seemed desirable to describe the Koshun specimens as a new subspecies because the body is longer, the scales seem smoother, the plates under the fourth toe are fewer, and eight of the nine specimens have only twenty-four scales around the middle of the body. But more than half of these specimens are very young and do not show the increase in body-length, and when one counts the scales a short distance in front of the middle of the body, he may find them twenty-six in number. Furthermore the coloration seems exactly like that of the specimens from the other localities.

The following notes show the variation and the amount of difference in some of the more important characters.

Scales around body	24	25	26	28
Koshun	7		2	
Other Formosan stations	2		26	
Pescadores	2	1	12	
China				5

Scales between parietals and backs of thighs.

Koshun	52 to 57	most frequent number 55	average 54.77
Other Formosan stations	50 to 55	" " " 53	" 52.68
Pescadores	53 to 55	" " " 53	" 53.73
China	53 to 55	" " " 55	" 54.40

Scutes under fourth toe.

Koshun	15 to 19	most frequent number 15	average 16.44
Other Formosan stations	17 to 21	" " " 19	" 19.14
Pescadores	15 to 18	" " " 17	" 17.
China	18 to 22	" " " 18	" 19.2

	Posterior Loreal touching two labials	*Posterior Loreal not much longer than high*
Koshun	44.4%	66.6%
Other Formosan stations	50.8%	18. %
Pescadores	70. %	80. %
China	90. %	60. %

Frontal not touching frontonasal.

Koshun	33. %
Other Formosan stations	43. %
Pescadores	26.6%
China	60. %

All these specimens have one postmental and no postnasal, upper temporal largest, and nuchals in three pairs, of which the first is largest. The supralabials are seven in all except one from Koshun, which has 6-6; one from Maru Yama, which has 8-8; three from Kanshirei, which have 6-7, 7-8, and 8-8; and two from the Pescadores, which have 6-6 and 6-7. The frontal touches three supraoculars in all except two from Koshun with 2-3 and 2-2, one from Kanshirei with 2-2, and one from the Pescadores with 2-3. All have the patch of much enlarged scales on the back of the thigh.

The chief differences between these lizards may be tabulated as follows:

a.—Usually with more than twenty-six rows of scales around middle of body.
China.
a^2.—Usually with not more than twenty-six scales around middle of body.
b.—Usually with twenty-six scales around middle of body.
c.—Scales under fourth toe 15 to 18.
Pescadores.
c^2.—Scales under fourth toe 17 to 21.
North Formosa.
b^2.—Usually with twenty-four scales around middle of body.
Koshun, Formosa.

Eumeces chinensis (Gray)

Diagnosis.—Two azygous postmentals; no patch of much enlarged scales on back of thigh; no postnasal; about fourteen plates under fourth toe; twenty-six or twenty-four scales around middle of body; frontal usually in contact with two supraoculars; nuchals usually in two pairs; interparietal less than twice as long as broad; frontoparietals not much longer than broad; dorsal line covering about half the width of the scales of one row on each side of midline; "middorsal line in young not bifurcating on head."

We have only one specimen, from Shanghai, China, August 3, 1906. The scales around the middle of the body are twenty-six, under the fourth toe fourteen, and on the back from the parietals to a line joining the backs of the thighs are fifty-four. The frontal is in contact with 2-3 supraoculars but does not meet the frontonasal. The supralabials are 6-7, two and three being in contact with the posterior loreals. There are two pairs of nuchals, two postmentals, and no postnasals.

Eumeces chinensis formosensis Van Denburgh

Diagnosis.—Normally with two azygous postmentals; no patch of enlarged scales on back of thigh; often with a postnasal; fourteen to sixteen plates under fourth toe; twenty-four or twenty-six scales around middle of body; frontal usually in contact with three supraoculars; two or three nuchals; interparietal about twice as long as broad; frontoparietals usually not much longer than broad; dorsal light line covering less than half the width of the scales of one row on each side of midline.

Type.—California Academy of Sciences No. 18605, **San Shi Ka, Formosa,** April 14, 1909.

Description of the type.—Nasal small, in contact with rostral, supranasal, postnasal, and first labial plates. Anterior loreal forming sutures with postnasal, supranasal, frontonasal, prefrontal, posterior loreal, and second labial. Posterior loreal longer than high, in contact with two labials. First labial touching rostral, nasal, postnasal, and second labial. Frontal separated from frontonasal, in contact with two supraoculars of each side. Parietals large, separated by a narrow interparietal. Three pairs of nuchals. Seven supralabials, the seventh largest, fifth entering eye. Two azygous postmentals. Scales smooth, twenty-five around middle of body, fifty-one in a row from parietals to line joining backs of thighs, middorsal rows not larger. Median subcaudal row broad. No patch of enlarged scales on back of thigh. Sixteen scutes under fourth toe. Hind limb reaching fingers.

Color above pale brownish gray, the scales of the back and sides margined with black, except in the positions of the middorsal and dorsolateral light lines. Sides and tail and upper surfaces of limbs similarly reticulated with black. Head gray, most of its plates being margined with black or dark brown along their posterior edges. Sides of neck and all lower surfaces yellowish white.

Length to anus	103	mm.
Length of tail (reproduced)	150	"
Snout to ear	19	"
Snout to forelimb	33	"
Fore limb	26	"
Hind limb	35	"
Base of fifth to end of fourth toe	14	"

Variation.—Four specimens are at hand. The scales around the middle of the body are 24, 26, 25, 24. The azygous postmentals are 1, 2, 2, 2. Scales along back from head to back of thighs are 50, 52, 51, 48. The nuchal scutes are 2-3, 2-3, 3-3, 2-2. The supraoculars in contact with the frontal are 3-2, 3-3, 2-2, 2-3. The scutes under fourth toe are 14, 15, 16, 15. Postnasals are absent in Nos. 18603 and 18604, but are one on each side in Nos. 18605 and 18606. In all, the supralabials are seven, the frontal is not in contact with the frontonasal, and the lower temporal is the larger.

Distribution.—The Academy's specimens were taken at San Shi Ka, Taipeh, and Keelung, Formosa, in April, 1909.

Eumeces kishinouyei Stejneger

Diagnosis.—Normally with two azygous postmentals; no patch of much enlarged scales on back of thigh; usually a postnasal; sixteen or seventeen scales under fourth toe; twenty-four or twenty-six scales around middle of body; frontal usually in contact with three supraoculars; nuchals usually three pairs; interparietal much less than twice as long as broad; frontoparietals often much larger than broad; dorsal light line covering much less than half the width of the scales of one row on each side of midline; middorsal line in young bifurcating on head.

Distribution.—We have received two specimens from Ishigaki shima, and five from the type locality, Miyakoshima, Loo Choo Islands, Japan. The species has been recorded also from Iriomote shima.

Variation.—The specimens at hand seem to be alike except that those from Ishigaki have the frontal in contact with the frontonasal, while in the Miyako lizards these plates are separated. However, at least one of Dr. Stejneger's specimens from Miyako had the frontal touching the frontonasal. All have seven supralabials. The number of plates under the fourth toe is either sixteen or seventeen. The Ishigaki specimens have the frontal touching 2-2 and 2-3 supraoculars, while in all the Miyako examples it is in contact with 3-3. The posterior loreals in the Ishigaki skinks touch 2-3 and 3-3 labials, while in the Miyako skinks they meet 2-3,2-2, 2-2,

2-3, and 2-2 labials. The number of scales in a row between the parietals and backs of thighs is 45, 47 in the Ishigaki specimens, and 46, 49, 46, 49, 48 in those from Miyako. Including the examples recorded by Stejneger, the scales around the middle of the body are 24, 24, 24, 26 in the Ishigaki specimens; 24, 26, 26, 26, 26, 24, 26, 24 in the Miyako; and 24, 26 in the Iriomote. The nuchals are 3-3, 2-3, 3-3, 2-2 in those from Ishigaki; 2-2, 2-3, 3-3, 2-3, 2-2, 3-3, 2-3 in those from Miyako; and 3-3, 3-2, 3-3 in those from Iriomote. All have two azygous postmentals except Nos. 21722 and 21723 from Miyako, which have only one. All have postnasals except Nos. 21719, 21720 and 21722 from Miyako, and one of Stejneger's from Iriomote, which have none. No. 21719 has the anterior azygous postmental divided. The younger specimens show a distinct bifurcation of the middorsal line on the head, much as in *E. elegans.*

Mabuya longicaudata (Hallowell)

Barbour has called attention to the fact that Fischer's figure of his specimen from "South Formosa" shows dorsal scales with only two keels, while Hallowell's specimen from Siam had three. Barbour examined a specimen from Saigon, Anam, and another from Mt. Wuchi, Hainan, and found that both had dorsal scales with three strong keels. Fischer's specimen has hitherto been the only one known from Formosa.

The California Academy has received one specimen of this lizard captured on Mt. Wuchi, Hainan, by one of Mr. Owston's collectors. This specimen has scales much more strongly keeled than any of the Formosan specimens at hand, and has dorsal scales with three equally developed keels. The frontonasal is in contact with the rostral, but is widely separated from the frontal by the prefrontals. The supralabials are seven, the fifth being much the largest. The eyelid is scaly. There is a single azygous postmental and one pair of nuchals. There are thirty scales around the body and forty-three from the parietals to a line joining the backs of the thighs. The ear-openings have three or four small scales projecting from the anterior border. The scales under the fourth toe are only nineteen or twenty in number.

Mabuya longicaudata ruhstrati (Fischer)

With six Formosan specimens at hand for examination it becomes evident that the *Mabuya* of this island should be recognized as a distinct subspecies characterized by the less extensive keeling of its scales. All six of these specimens have smooth scales on the side of the neck between the ear and fore limb, where the scales are strongly keeled in the specimen from Hainan. Five have dorsals with only two strong keels, while one (No. 18609) has them with a third (central) keel not quite so strong as the other two. Of the five with bicarinate scales, two show a weak central keel on some of the scales. All of the keels are much weaker than in the Hainan lizard. The scales under the fourth toe are either twenty-three, twenty-four or twenty-five, as against nineteen or twenty in the Hainan specimen. It appears, therefore, that the differences between the Formosan and the continental forms of this lizard are real, but probably not entirely constant. It therefore seems best to use a trinomial for the smoother, bicarinate form, and since Fischer's *Euprepes ruhstrati* was based on a specimen of this character from "South Formosa," this name is available.

Variation.—The frontonasal does not touch the rostral in any of these specimens, but does in Fischer's figure. It touches the frontal in four specimens, and is separated from this plate in two. The labials are 7-7 in all, the fifth being much the largest. Usually the first and second supraoculars touch the frontal, but in two specimens only the second is in contact with this plate on one side of the head, and in No. 18610 only the second on both sides. All have one azygous postmental. All have two or three small projecting scales on the anterior border of the ear-opening, but in No. 18607 these are very small. Only No. 18612 has thirty scales around the middle of the body (as in the Hainan specimen); No. 18608 has twenty-nine; the other four have twenty-eight. The number of scales from the parietal plates to a line joining the backs of the thighs is forty-four in two specimens, forty-five in three, and forty-six in one. The plates under the fourth toe are twenty-three in one specimen, twenty-four in three, and twenty-five

in two. All have the lower eyelid scaly. No. 18610 has the left prefrontal merged with the frontal and frontonasal.

Nos. 18607 and 18608 are from Tainan, Formosa; the others, from Koshun. All were taken in March, 1909.

Sphenomorphus indicus (Gray)

This species has been recorded as occupying an extensive territory extending from the eastern Himalayas, Assam, and Burma to eastern China and Formosa. Although it has been regarded as a homogeneous species, there can be no doubt that the examination of large series of specimens from various parts of this range will result in the recognition of distinct races or subspecies.

The collection under consideration includes series of nine specimens from Mohkanshan (altitude 1000 to 1500 feet) near Huchow, Che-kiang, China, and eighty-two specimens from Formosa. These series are found to differ in scale counts to an extent which renders desirable their separation as subspecies. It is to be regretted that there are at hand no specimens from India for comparison, but the Chinese specimens agree so well with Boulenger's description that I shall, for the present, regard them as identical with the types from the Himalayas. The Formosan form, therefore, should receive a new name.

These Chinese specimens all have either thirty-six or thirty-eight rows of scales about the middle of the body, the former number being found in only four and the latter in five specimens or 55.5%. In the Formosan series thirty-eight scale rows are found only once (1.2%) while either thirty-six or thirty-eight rows occur in less than 37.5% of the specimens as against 100% of the Chinese. The scale rows are thirty-four in about 60% (49 specimens) of the Formosan examples, while this number does not occur in the Chinese series at hand, although Boulenger has reported this count in specimens from Fokien.

The number of scales in a row from the parietal plates to a line joining the backs of the thighs varies from seventy-three to eighty-one in the Chinese, with an average of 76.6. In the Formosan lizards this count ranges from sixty-four to seventy-eight, with an average for the eighty-two specimens of only 71.

In the nine Chinese lizards the frontal is separated from the frontonasal in three or 33%; while in the eighty-two from Formosa this condition is found in only three or 3.6%.

In the both series three supraoculars normally are in contact with the frontal, but in two of the Chinese and three Formosan examples, only two supraoculars touch the frontal on one side of the head. No specimen has the number reduced to two on both sides.

The supralabials normally are seven in both Chinese and Formosan lizards, but may be 7-8 or 8-8. All have a single unpaired postmental and individual preanal.

Spenomorphus indicus formosensis Van Denburgh

Diagnosis.—Like *S. indicus* but with fewer scale rows, usually thirty-four or thirty-six about middle of body, and not more than seventy-eight (average 71) between parietal plate and line joining backs of thighs; frontal very rarely separated from frontonasal.

Type.—California Academy of Sciences No. 18622. **Kanshirei, Formosa,** March 24, 1909.

Description of the type.—Snout short and rather blunt. Rostral moderate, in contact with frontonasal. Frontonasal touching anterior loreal, prefrontals, and frontal. No supranasals. Frontal long, very narrow behind, in contact with anterior three large supraoculars. Four large supraoculars. Frontoparietals and interparietal distinct. Parietals short, with a short suture behind small interparietal. No nuchals. Nostril in a single nasal. Three loreals, anterior high, in contact with frontonasal and prefrontal; middle largest. Seven supralabials, fifth and sixth largest. Largest temporal touches parietal. Lower eyelid covered with scales, no single transparent disk. Ear-opening moderate, without lobules. A single azygous postmental. Thirty-four scale rows around middle of body. Seventy scales in a row from parietal to a line joining backs of thighs. Two very large central preanals, with small lateral pair. No patch of enlarged scales on back of thigh. Inferior midcaudal scales enlarged. Twenty-one scales under fourth toe. Longest toe reaches elbow.

The color above is olive brown, lighter on the tail and just above the lateral dark band, with scattered blackish dots. A light brown lateral dark band from nostril to eye and from eye to above hind limb, relieved with many lighter dots. Limbs olive with a few dark and light dots. Lower surfaces greenish white. Labials without distinct dark spots.

Length to anus	72	mm.
Length of tail	133	"
Snout to ear	14	"
Width of head	10	"
Fore limb	21	"
Hind limb	33	"
Base of fifth to end of fourth toe	12	"

Variation.—The scale rows are thirty-two in two specimens, thirty-four in forty-nine, thirty-six in thirty, and thirty-eight in one. The number of scales between a parietal and a line joining the backs of the thighs ranges from sixty-four to seventy-eight, the average being seventy-one, and the most frequent number seventy-two: 64 in 1 specimen, 65 in 2, 66 in 4, 67 in 1, 68 in 9, 69 in 8, 70 in 10, 71 in 7, 72 in 17, 73 in 6, 74 in 10, 75 in 2, 77 in 3, and 78 in 2. All have one azygous postmental and two large preanals. The frontal is in contact with the frontonasal in all but three of the eighty-two specimens, and with three of the large supraoculars in all except that in three specimens it touches only two on one side of the head.

Distribution.—Mr. Barbour has recorded two specimens from Bankoro, Central Formosa. The Academy has received one from Jenshiko, two from San Shi Ka, and seventy-eight from Kanshirei, Formosa, where they were collected in March and April 1909. The data at hand are insufficient to enable one to judge whether or not the Fokien specimens recorded by Dr. Boulenger[1] belong to this subspecies.

Sphenomorphus boulengeri Van Denburgh

Diagnosis.—Ear-opening without projecting lobules anteriorly; frontonasal broadly in contact with frontal and rostral; four large supraoculars, two or three in contact with frontal; thirty-eight or forty scales around body; snout elongate; first supraocular usually nearly twice as long as second; frontoparietal and interparietal distinct; no supranasal; lower eyelid scaly; a distinct patch of much enlarged scales on back of thigh.

Type.—California Academy of Sciences No. 18700. **Koshun, Formosa,** March 14, 1909.

Description of the type.—Snout longer than in *S. indicus*. Rostral large, with a considerable flat superior surface, broadly in contact with frontonasal. Frontonasal touching anterior loreal, prefrontals and (broadly) frontal. No supranasals. Frontal long, narrow behind, in contact with anterior two large supraoculars. Four large supraoculars. Frontoparietals and interparietal distinct. Parietals short, with a short suture behind small interparietal. A pair of small lateral nuchals. Nostril in a single nasal or between two nasals. Three loreals; anterior high, in contact with frontonasal and prefrontal; middle largest. Seven supralabials, fifth and sixth

[1] Boulenger, P. Z. S., 1899, p. 162.

largest. Largest temporal touches parietal. Lower eyelid covered with scales, no single transparent disk. Ear-opening moderate, without lobules. A single azygous postmental. Thirty-eight scale rows around middle of body. Seventy scales in a row from parietal to a line joining backs of thighs. Two very large preanals, with small lateral pair. A patch of enlarged scales on lower part of back of thigh. Inferior midcaudal scales slightly enlarged. Twenty-one scales under fourth toe. Longest toe reaches axilla.

The color above is dark olive brown on head, limbs, back, and tail. The back has scattered blackish brown dots near the midline, and along the pale yellowish brown dorsolateral line which extends from the temporal region more or less indefinitely to the base of the tail. A blackish-brown band, relieved with numerous scattered light dots on the sides, extends from the nostril to and below the eye, and from the eye to the base of the tail, being bordered below by a definite light lateral line. Below this line, starting as brown spots on the labials, is a dark band more or less indefinite on the body. The limbs are reticulated with dark brown. The lower surfaces are pinkish white.

Length to anus	78	mm.
Length of tail (tip reproduced)	111	"
Snout to ear	16	"
Width of head	12	"
Fore limb	24	"
Hind limb	37	"
Base of fifth to end of fourth toe	15	"

Variation.—Of twelve specimens at hand, eight have scales in thirty-eight rows, and four in forty rows. The scales between the parietal and back of thighs are sixty-seven in one specimen, seventy in three, seventy-two in two, seventy-three in one, seventy-four in three, seventy-six in one, and seventy-eight in one. All have the patch of enlarged scales on the back of the thigh. All have a single azygous postmental; frontal in contact with frontonasal, and two large preanals. Five have the frontal touching only two large supraoculars on both sides, five have this plate touching three supraoculars, and two have it in contact with two on one side and three on the other. All are darker than *S. indicus* and show more definite dark and light lateral bands than appear in any of the specimens of that species at hand.

Two specimens from Botel Tobago, (Nos. 25110, 25111) purchased of Mr. Kukuchi, collector for the Taihoku Museum, seem to differ from the Formosan ones only in their general darker coloration and the presence of more numerous dark spots on the back. The scale rows are thirty-eight and forty; scales between parietal and back of thigh seventy-seven and eighty-two; supraoculars in contact with frontal 2-2 and 3-3;

scales under fourth toe twenty-two and twenty-three: frontal touching frontonasal; two large preanals; one postmental; patch of enlarged scales on back of thigh, as in *Eumeces elegans.*

Remarks.—Although this is a perfectly distinct species, readily distinguished by the enlarged scales on the back of the thigh, the longer snout, the coloration, and the larger number of scale rows, its general appearance is so like that of *S. indicus* that it was at first confused with that form. I believe that the specimen described by Dr. Stejneger in his *Herpetology of Japan*, p. 216, really is this species, although Barbour's two specimens are undoubtedly *S. indicus formosensis.* Although the proportions of the first and second supraoculars, and the relation of these plates to the frontal, and the patch of enlarged scales on the back of the thigh, indicate relationship with *S. jagorii* of the Philippine Islands, the present species differs from that species in many respects. Thus, in *S. jagorii* the snout is shorter, the parietals are much larger, the scales around the body usually are thirty-six, the frontonasal is convex instead of nearly flat, and the coloration is quite different.

The occurrence in Formosa of two similar species of *Sphenomorphus* is quite as unexpected and remarkable as the presence there of *Takydromus formosanus* and *T. stejnegeri.*

Distribution.—We have received five specimens from Kosempo, and seven from Koshun, Formosa, where they were secured in March, 1909; also two from Botel Tobago. The specimen, in the British Museum, described by Stejneger, was collected by La Touche at Bangkimtsing, Formosa.

Emoia atrocostata (Lesson)

This genus has not been recorded from either Formosa or the Loo Choo Islands. We now have five specimens (Nos. 21714-21718) from Miyakoshima and ten from Formosa. These agree so well with Boulenger's description of *E. atrocostata* that they must be regarded as representing this species, at least until direct comparison shows them to be distinct. Specimens from near the type locality not being at hand, such comparison cannot now be made.

I have been unable to detect any points of difference in the two series, from Formosa and the Loo Choos. The scale rows around the body vary from thirty-four to thirty-eight in the Formosan, from thirty-six to thirty-nine in the Miyako specimens. All have a supranasal plate on each side, and one azygous postmental. One specimen from Formosa has the left parietal united with the frontoparietal, another has the frontal united with the right prefrontal. The frontal is in contact with the frontonasal in four specimens from Formosa and three from Miyako shima, separated in the others. The scales under the fourth toe vary from thirty-two to thirty-seven in those from Miyako, and from thirty-one to thirty-five in those from Formosa. The scales in a row from the parietals to a line joining the backs of the thighs range from sixty-six to sixty-nine in the Loo Choo lizards, and from sixty-two to seventy-one in the Formosan.

One of the Formosan specimens was taken at Nanto, east of Taichu, March 9, 1909. The others were secured at Koshun, March 14, 1909. One of the latter contains eggs nearly ready for laying.

In the Taiwan Museum are specimens said to have been collected on Pratas Island and Botel Tobago.

A specimen from the Philippine Islands has forty-four scales around the body, sixty-three on the back, thirty-seven or thirty-eight under the fourth toe, and eight supralabials. There can be little doubt that careful examination of large series would show that this is not a homogeneous species.

Emoia cyanura (Lesson)

One specimen (No. 14958) of this widely distributed lizard was secured from Mr. Owston. It is labeled as having been collected on Wake Island in October, 1903. There are thirty scales around the middle of the body.

Leiolopisma laterale (Say)

This lizard has long been known from China, and Dr. Boulenger upon direct comparison of Chinese and American specimens was unable to find any character distinguishing them. It has more recently been recorded from Okinawa and

December 13, 1912.

Miyako shima in the middle and southern Loo Choo groups. Dr. Stejneger has carefully compared the specimen from Miyako with the American lizards and agrees with Dr. Boulenger as to their identity. However, both were compelled to work with very limited material and it is possible that the examination of good series of specimens would change their conclusion. It is much to be regretted that we have not now at hand enough Chinese specimens to give trustworthy results upon comparison with the other series in the Academy's collection.

We have received no specimens of this lizard from either Okinawa or Miyakoshima, and have none from China, but have one from Tsushima and good series from Ishigaki, Formosa, and the United States.

While lack of Chinese specimens prevents any direct comparison with the form found on the Asiatic mainland, the records in the literature make it evident that this Asiatic form usually has a greater number of scales around the middle of the body than is found in American specimens. The specimen from Tsushima agrees in every respect with the descriptions of the Chinese lizards. The American lizards also differ from all Asiatic specimens in coloration. Since the scale counts overlap, the two forms cannot be regarded as distinct species, but are certainly entitled to stand as separate subspecies.

When we consider the specimens from Formosa and Ishigaki we find that they differ from those from America and the Asiatic mainland in having fewer scales in a longitudinal dorsal row. The Ishigaki lizards differ from the American and Formosan forms in the greater number of scales around the middle of the body, and differ from these last and from the Chinese in having the frontal nearly always separated from the frontonasal. These differences also are not constant, but occur in so large a percentage of individuals as to make their recognition as subspecies desirable.

These principal differences are set forth in the following

KEY.

a.—Scales on back more numerous, average more than 65 in a row between parietals and backs of thighs, average more than forty on back between insertions of limbs;

b.—Scales around middle of body usually 26, often 28; dark lateral band with very definite lower border; frontal in contact with frontonasal; North America.
L. laterale laterale.

b².—Scales round middle of body 28 to 34, rarely 26; dark lateral band usually without definite lower border; frontal usually in contact with frontonasal; China and Tsushima.
L. laterale reevesii.

a².—Scales on back fewer, average fewer than 65 in a row between parietals and backs of thighs, average fewer than 40 on back between insertions of limbs;

bb.—Frontal usually in contact with frontonasal; scales around middle of body usually 28, often 26, rarely 30; scales in a row between parietals and backs of thighs 53 to 65, average 57.6; most frequent number 65; Formosa.
L. laterale formosensis.

bb².—Frontal usually not in contact with frontonasal; scales around middle of body usually 30, often 28, rarely 32; scales in a row between parietals and backs of thighs 59 to 66, average 62.6, most frequent number 61; Ishigaki.
L. laterale boettgeri.

Leiolopisma laterale laterale (Say)

A few notes on the series of twenty-three specimens before me may be of interest for comparison with the Asiatic forms. These specimens are from Texas, North Carolina and Florida.

All have two large preanals, one azygous postmental, and the frontal in contact with two large supraoculars of each side, and also with the frontonasal. In six specimens examined the lamellae under the fourth toe are fifteen in four, and sixteen in two. The number of scales in a row from the parietals to a line joining the backs of the thighs ranges from sixty-one to seventy-two, the most frequent number being sixty-five and the average sixty-seven and eight-tenths. The scales around the middle of the body are twenty-six in sixteen instances, and twenty-eight in seven. The supralabials normally are seven, but may be six or eight.

Leiolopisma laterale reevesii (Günther)

The single specimen (No. 26134) from Tsushima was caught in a thicket October 5-15, 1910. It has twenty-eight scales around the middle of the body, sixty-nine on the back between the parietals and a line joining the backs of the thighs, and forty-seven on the back between the insertions of the limbs.

The frontal does not touch the frontonasal. There is one azygous postmental. The frontal is in contact with two supraoculars on each side. There are only twelve scutes under each fourth toe.

It is interesting to be able to confirm Boettger's original record of the presence of this lizard on Tsushima.

Leilopisma laterale formosensis Van Denburgh

Diagnosis.—Similar to *L. laterale* but with fewer (53 to 65) scales in a row on back between parietals and a line joining backs of thighs; scales around middle of body usually 28, often 26, sometimes 30; dark lateral band without very definite lower border; limbs usually overlapping when adpressed; frontal usually in contact with frontonasal.

Type.—California Academy of Sciences No. 25,027. **Kanshirei, Formosa, Japan,** March 20, 1909.

The nineteen Formosan specimens all have two large preanals, one azygous postmental, and the frontal in contact with two large supraoculars. Two specimens have a small plate between the frontal, prefrontals and frontonasal. Three have prefrontals meeting between the frontal and frontonasal. In the other fourteen the frontal is in contact with the frontonasal. In four specimens examined the lamellae under the fourth toe vary from fourteen to seventeen. The number of scales in a row from the parietals to a line joining the backs of the thighs ranges from fifty-three to sixty-five, the most frequent number being fifty-six and the average fifty-seven and six-tenths. The scales around the middle of the body are twenty-six in seven specimens, twenty-eight in eleven, and thirty in one. The adpressed limbs in the Formosan specimens usually overlap, and when they fail to meet, the distance between them never is as great as that between the snout and ear. In the other forms the limbs rarely meet.

From Formosa we have nineteen specimens, one from Jenshiko and the others from Kanshirei. All were collected in March, 1909, and some contain eggs which seem ready for expulsion.

Leiolopisma laterale boettgeri Van Denburgh

Diagnosis.—Similar to *L. laterale* but with frontal usually separated from the frontonasal by prefrontals; scales around body more numerous, twenty-eight to thirty-two rows around middle of body; fewer scales in a longitudinal row on back. Dark lateral band broader and with less definite lower border.

Type.—California Academy of Sciences No. 21,678. **Ishigaki shima, Loo Choo Islands, Japan,** May 25 to June 2, 1910.

This subspecies seems to differ from the Formosan series in the separation of the prefrontal and frontal plates, the greater number of scales, the less slender habit, and the coloration. The prefrontals separate the frontal from the frontonasal in all but two of the thirty-seven specimens (94.6%), while this condition is found only in three (15.8%) of the nineteen specimens from Formosa. Many of the Ishigaki specimens are very young. For this reason, the scales have been counted in only twenty-six from this island. The number around the body is twenty-eight in ten specimens, twenty-nine in one, thirty in fourteen, and thirty-two in one. This is two scales more than in the Formosan lizards. 61.5% have more than twenty-eight scale rows as against 5.2% of the Formosan; or, in other words, only 38.5% have not more than twenty-eight scale-rows, as against 94.7% of the Formosan. The number of scales in a series from the parietal to a line joining the backs of the thighs varies from fifty-nine to sixty-six, the most frequent number being sixty-one, and the average sixty-two and six-tenths as against the Formosan average of fifty-seven and six-tenths—a difference of five scales. All have a much broader dark lateral band than is found in the Formosan lizards.

It is a pleasure to associate with this lizard the name of the well-known herpetologist, the late Dr. Oskar Boettger.

All our specimens are from Ishigaki. *Leiolopisma laterale* has been recorded from two other islands of the Loo Choo group—Okinawa and Miyako—but we are unable to say whether or not they are identical with the Ishigaki examples.

Lygosaurus pellopleurus Hallowell

This lizard must be rather rare on Okinawa, for only four specimens were secured there. They were taken between May 5 and 11, 1910. Three have scales in twenty-six rows, and one in twenty-eight. Their scales are strongly carinate, the keels varying from three to five in number. The frontal is entire in three specimens, divided in one. If one may judge from so small a series and the few specimens recorded by authors, it seems probable that larger series may establish the fact that the frontal is much less frequently divided in the Okinawa than in the Amami specimens, and perhaps that the scale rows are on the average more numerous in the Okinawa form.

Lygosaurus pellopleurus browni Van Denburgh

When one compares directly the lizards of Okinawa with those of Amami Ō shima he is at once struck by the much stronger keeling of the scales in the specimens from the former island. The Amami Ō shima specimens appear much smoother, and, upon examination, many specimens are found in which the laterals and the nuchals are without keels, while the majority have at most only the two central rows of nuchals keeled. Unfortunately we have only four specimens from Okinawa, but upon carefully selecting the most strongly keeled specimens (Nos. 21386, 21419, 21509 and 21522) from a series of more than one hundred and fifty from Amami it appears that even these are somewhat less strongly keeled than the Okinawa examples. There seems, therefore, to be no doubt that the lizards of these two islands should be regarded as distinct subspecies.

Hallowell, in describing *Lygosaurus pellopleurus* mentioned specimens from both islands without indicating either as the type locality, but, since nearly all later definite records refer to Okinawa, it seems best to restrict Hallowell's name to the lizards of that island and to make Amami Ō shima the type locality of the new subspecies. It is a pleasure to associate with this new lizard the name of the late Arthur E. Brown of Philadelphia.

Diagnosis.—Like *Lygosaurus pellopleurus* but with scales less strongly keeled; the lateral nuchals usually smooth; the laterals smooth or weakly keeled.

Type.—California Academy of Sciences No. 21408, **Amami Ō shima, Loo Choo Islands, Japan,** April 26 to May 1, 1910.

Description.—The description of Hallowell's species given by Stejneger applies so completely to this subspecies that no detailed description is needed here.

Length to anus	61	mm.
Length of tail	76	"
Snout to ear	10	"
Fore limb	10	"
Hind limb	17	"
Base of fifth to end of fourth toe	5	"

Variation.—There is considerable variation as regards the keeling of the scales in different specimens. As stated above, a few approach the condition found in the Okinawa examples. One, No. 21445, has all scales smooth except on the posterior part of the back and the base of the tail, where they are very weakly keeled. A considerable number have the laterals and a few (usually two) of the central rows of nuchals weakly keeled. A very large number have the laterals and nuchals smooth. The number of keels on a scale is usually three, but may be five.

Fifty specimens, taken at random from the series have been examined as to the number of scale-rows and the condition of the frontal. One has twenty-eight rows, twenty-nine have twenty-six rows, and twenty have twenty-four rows. The frontal is transversely divided in thirty-five specimens, and entire in fifteen.

Cryptoblepharus boutonii nigropunctatus (Hallowell)

Two specimens (Nos. 14959 and 14960), secured from Mr. Owston, are from Haha shima, Bonin Islands. One has twenty-six, and the other only twenty-four scales around the middle of the body, the numbers found by Stejneger in ten specimens examined by him (six 24, four 26). Both have distinct postnasals.

Takydromus dorsalis Stejneger

The collection includes thirty-one specimens of this very distinct species. All are from the type locality, Ishigaki shima, in the southern Loo Choo group, to which island this lizard seems to be confined.

These specimens agree so well with Dr. Stejneger's description that only a few remarks on variation are necessary. The ventrals are in six longitudinal rows in all the specimens, the scales of the outer rows being strongly keeled, while those of the central rows are smooth in twenty-three specimens, and weakly or moderately keeled in eight. All have one large smooth preanal. All have four pairs of large chin-shields, except one (No. 21183) which has four on one side and five on the other. The first pair of chin-shields are partially united in No. 21206. The inguinal pores are 2-2 in sixteen specimens, 2-3 in six, and 3-3 in nine. The superior labials normally are six; but ten specimens have them 6-7, one (No. 21187) 5-6, and one (No. 21192) 7-7. The rostral is in contact with the internasal only in Nos. 21180, 21181, 21200. The color above is a bright grass green. The lower surfaces of the limbs and tail are yellowish. The other lower surfaces are greenish or yellowish white. There are no longitudinal lines except on the sides of the head, where there usually is a white or yellowish band edged above with black.

This is one of the elongate species of the genus. The largest specimens measure 63 *mm.* from snout to vent with tails 241 and 232 *mm.* long. The tails are usually from three to three and one-half times the length of the head and body.

Takydromus septentrionalis Günther

Twelve specimens from Mohkansan (altitude 1000 to 1500 feet) and Hu-chau, Che-kiang, China, are doubtless identical with Günther's original specimens from Ningpo. They differ from the Formosan lizard as stated in discussing *T. stejnegeri.* The principal difference in color is that in Chinese specimens the greenish blue of the belly often extends up on the sides leaving spots of the original brownish ground-color.

These twelve Chinese specimens all have three postmentals and one inguinal pore on each side. All have two rows of

large dorsals on each side, except one which has two on one side while a third row may be made out on the other side. The small dorsal rows may be 3-2,3-2-1, 2-2, or most frequently 2-1. The ventrals are in eight rows, keeled, with two or three rows of smaller keeled laterals above them on each side. Eleven have a single, large, smooth preanal, while one has two keeled scales. The labials usually are 6-6, but may be 6-7 or 5-6. The rostral touches the internasal in eight and is separated in four. All twelve have the first large supraocular separated from the loreal by a small plate, except No. 16499. This supraocular is in contact with the first superciliary in ten specimens, while in the other two it is separated by a row of small granules.

Takydromus stejnegeri Van Denburgh

This is the Formosan lizard now known as *Takydromus septentrionalis,* the one-pored species which has just been compared with *T. formosanus* under the latter heading.

Takydromus septentrionalis originally was described by Dr. Günther from specimens from Ningpo, Che-kiang, China. In the Academy's collection are twelve specimens from the vicinity of Hu-chau, in the same province as the type locality, which show that the Formosan species is quite distinct from that found on the mainland. The principal points of difference are: that the large dorsal rows are only two on each side in the mainland specimens, while they always are three in those from Formosa; the rostral usually touches the internasal in the Hu-chau specimens, but usually is separated in the Formosan; the mainland species is larger and differs in coloration.

Diagnosis.—General form not much elongate; chin-shields in three pairs; a single inguinal pore; large ventrals in eight rows, keeled; anterior supraocular usually not separated from superciliary by granules; enlarged lateral scales above the ventrals; rostral usually not touching internasal; general color olive or brownish with or without lateral and dorsolateral light lines.

Type.—California Academy of Sciences, No. 18417. **Taipeh, Formosa,** March 10, 1909.

Description.—Rostral separated from internasal by anterior nasals; nostril between anterior and posterior nasals; two loreals, posterior larger, separated from the anterior large supraocular by a small plate; two large supraoculars, in contact with frontal, anterior in contact with first superciliary, other superciliaries separated by a row of granules; six supralabials, fifth very large, under eye; temporals moderate, keeled; three pairs of postmentals; back with three rows of large keeled scales on each side, separated by smaller keeled scales, which are in two rows anteriorly—one row on the middle of the back—and none posteriorly; laterals granular except three rows of keeled scales above the ventrals; ventrals strongly keeled, in eight longitudinal and twenty-eight transverse rows; preanal single, large, smooth, with two smaller plates on each side; one inguinal pore on each side; limbs moderate, the hind leg carried forward reaches the shoulder; tail about three and two-thirds times as long as head and body, covered with strongly carinate scales.

The color above is brownish olive becoming lighter yellowish brown on the head, tail, and limbs. The large dorsals are marked with dark brown, which in places forms narrow dark lines along the keels of the scales. A light greenish white line starts at the superciliaries, runs along the upper half of the outer and lower half of the second row of large dorsal scales to the base of the tail. A second light streak starts at the nostril, crosses the loreals, the lower eyelid, the lower part of the ear-opening, and the side of the body, partly on and partly above the upper row of enlarged laterals. It is bordered above by a narrow black line from the nostril to a point above the axilla. It passes, in part, below the ear-opening. There are black lines on the posterior surfaces of the limbs. The lower surfaces are greenish white, becoming yellowish on the tail.

Length to anus	51	mm.
Length of tail	184	"
Snout to ear-opening	12.5	"
Width of head	7	"
Fore leg	20	"
Hind leg	28	"
Base of fifth to end of fourth toe	12	"

Variation.—What has been said in connection with *T. formosanus* need not be repeated here. In the one hundred and five specimens at hand the postmentals are in three pairs, except in two specimens (Nos. 18488, 18547) in which they are 3-4. The inguinal pores are 1-1, except in No. 18360 which has 1-2. The anterior supraocular is in contact with the superciliaries on both sides in ninety-five specimens, on one side only in one specimen, and separated on both sides in nine specimens, including one (No. 25046) of ten specimens from the Pescadores, where *T. formosanus* has not been found. The large ventrals are in eight keeled rows, with two or three rows of smaller enlarged laterals above them. The large dorsals always are in three rows on each side. The small dorsal rows are almost always two anteriorly, but almost never more than one, and often none, posteriorly. There may be only one small row anteriorly. The rostral is separated from the internasal in

ninety-eight specimens, in contact in seven. The large preanal is a single smooth plate in seventy-seven specimens, a large plate with two keels in twenty-four, two keeled scales in three, and two smooth scales in one. Of forty-seven specimens from Formosa examined, the loreal meets the large anterior supraocular on both sides in two, on one side in three, and not at all in forty-one. The supralabials normally are six, but show a very strong tendency toward reduction to five.

The collection contains specimens from Taipeh, San Shi Ka, Taihoku, Polisia, Koshun, Tainan, and Takao, Formosa, and the Pescadores. Those recorded formerly by mistake from Keelung are really *T. formosanus*.

It is with much pleasure that this lizard is named for Dr. Stejneger, who first recorded it from Formosa, and has given an excellent description in his Herpetology of Japan (p. 232).

Takydromus formosanus Boulenger

This lizard was first described by Boulenger, in 1894, from several specimens collected by Mr. Holst at Taiwan, Formosa. Dr. Stejneger was inclined to question its distinctness from a series of nine lizards from Taipe, Formosa, which he records as *Takydromus septentrionalis* Günther, although he thought it best to regard them as distinct until further evidence came to hand. This view of Dr. Stejneger was certainly a very natural one, and Dr. Boulenger deserves much credit for recognizing the two forms as distinct, with the limited material which he had for study.

Alcoholic specimens of the two species resemble each other so closely in squamation and coloring that, even with more than two hundred and eighty specimens, I at first regarded them as representing a single species with pores varying from one to two in number. It was only upon more critical study that the fact that there were two quite distinct species became evident.

There seem to be only three points of value in distinguishing the two forms. These are the number of pores, the separation by granules of the large anterior supraocular and the superciliary scales, and the position of the dark and light lines where they cross the ear-opening. In all other respects the two species seem to be alike except that *T. formosanus* seems

to be a little smaller and to have the dorsal scales usually a little more regular in arrangement.

Unfortunately no one of these distinctive characters is absolutely constant in all specimens. Thus No. 18441, a female from Kanshirei, has only one pore on each side although it is undoubtedly a *T. formosanus,* as shown by the separation of the supraocular and superciliary, the position of the ear-stripe and the presence of the merest trace of a second pore on each side. Nos. 18440, 18250, and 18238, all from Kanshirei, are quite similar except that the second pores are a little more evident. In the whole series of two hundred and eighty-four specimens there are eight which show two pores on one side and only one on the other. (Nos. 18274, 18275, 18317, 18330, 18356, 18360, 18376, 18378). Of these, all but two have the supraocular separated (Nos. 18356 and 18360), and all but one (18360) have the ear-stripe high. This last specimen (No. 18360) is the only one which may occasion any doubt; all the others are *T. formosanus,* as are one hundred and seventy specimens with two pores on each side.

If now we examine the one hundred and seventy-eight examples of *T. formosanus,* the two-pored species, as regards the separation of the supraocular from the superciliary by granules and contrast our findings with the results of a similar examination of one hundred and five specimens of the one-pored form, the value of this second character is strongly brought out. In the two-pored species the first large supraoculars are completely separated from the superciliaries by granules in one hundred and sixty-three specimens or 91.6%, while in the one-pored species this condition is found in only nine specimens or 8.6%. Of the fourteen specimens of *T. formosanus* having supraoculars not completely separated, three show this condition only on one side of the head, three have them nearly separated on both sides, leaving less than 4.5% with complete contact as against 90.5% in the one-pored species.

The difference in position of the color-bands near the ear is very slight but none the less real. In *T. formosanus* these markings are placed a little higher than in the other species, so that the lower edge of the light stripe does not extend below the lower margin of the ear-opening, as it does in the one-pored

species. This difference is not quite constant, but nevertheless it is of considerable aid in separating specimens of the two kinds.

Both species occur in western Formosa from the northern part of the island southward at least to Tainan. It certainly is most unusual to find in the same area two species so closely related yet so constantly distinct*; and I suspect that it will be found that their local distribution is different, either as regards altitude or the character of the country. This is indicated by the fact that the two were not collected on the same dates even where, as at Tainan, both are labeled as from the same locality. Otherwise, it is difficult to understand how the two species could remain distinct, unless they breed at different seasons.

Takydromus formosanus always (178 specimens) has three postmentals on each side. The ventral rows are never less than eight, and may be ten when one of the lateral rows is more than usually enlarged. They are strongly keeled. There normally are three rows of enlarged laterals, of which the upper corresponds to the lateral row in *T. smaragadinus*. The large dorsals always are in three rows on each side. The small rows between these often are two throughout, but frequently are reduced to one row posteriorly. Rarely there is only one small row anteriorly, and one or none posteriorly. The posterior reduction is much less constant than in the one-pored species. The rostral is separated from the internasal in one hundred and fifty-eight specimens, and in contact with this plate in twenty. The large preanal is a single smooth plate in one hundred and fifty-seven specimens, a single plate with two keels in five, two keeled scales in four, and two smooth scales in twelve. The supralabials normally are six, but may be five or seven. The loreal is, of course, separated from the large anterior supraocular.

The collection includes specimens from Keelung, Jenshiko, Polisia, Kanshirei and Tainan, Formosa.

Takydromus smaragdinus Boulenger

This lizard was first described from specimens labeled merely, Loo Choo Islands. It has since been definitely recorded from

* The overlapping of characters found seems to be pure individual variation.

Okinawa and Miyakoshima. We are now able to add to these localities Amami Ō shima and Kikaiga the easternmost island of the group.

Our collection contains one hundred and fifty-one specimens, as follows: 89 from Kikaiga, 42 from Amami Ō shima, 18 from Okinawa, and 2 from Miyako. The species was not found in either Ishigaki or Iriomote shima, so that it would seem that Miyako shima is the southernmost point of its distribution.

Throughout this extensive range the species shows but little variation. Thus, all the specimens have one inguinal pore on each side. Nevertheless, certain tendencies toward differentiation appear when one critically examines large series from the various islands. It is unfortunate that there are at hand only two specimens from Miyako, for these seem to differ most.

The two specimens from Miyako each have eight rows of large ventrals (the outer being a little smaller) with two more rows of smaller keeled scales on each side just above them. None of the lizards from the more northern islands show more than six rows of full-sized ventrals, although a very few from each island (nine in all) have a row of much smaller keeled scales just above. All of the ventrals are keeled in all specimens.

The dorsal rows, both large and small scales, usually are more numerous on the anterior part of the back than posteriorly. Thus, in the Kikaiga, Amami and Okinawa specimens, the count most often is of large scales four rows anteriorly and three posteriorly, and of small scales two rows anteriorly and one posteriorly. The large rows vary from three to five, and the small from two to none. A few specimens from Amami and Kikaiga (as Nos. 21089, 21031, and 21131) have dorsals all nearly equal in size, so that one counts eight or ten rows. In the two specimens from Miyako, on the other hand, there appears a tendency toward reduction in the number of dorsal rows; so that we find in one example three large rows on each side, separated anteriorly by two, and posteriorly by one small row; while in the other example the arrangement is the same, except that the large rows are reduced to two posteriorly.

The large chin-shields are as follows:—

NUMBER OF CHIN-SHIELDS	3-3	3-4	4-4
Kikaiga specimens	70	11	8
Amami Ō shima specimens	36	5	3
Okinawa "	18	0	0
Miyako "	1	0	1

The supralabials normally are six, but may be either five or seven. Both specimens from Miyako have seven.

The large preanals may be two separate keeled scales, or two keeled scales partially united, or a single large plate with two keels. The last is the usual condition except on Okinawa, where two is the more frequent number. These conditions are shown in the following table:

PREANALS	Two Separate	Two United	One 2 Keels	One Smooth
Kikaiga shima	28	3	58	0
Amami Ō shima	15	0	26	1
Okinawa shima	11	1	6	0
Miyako shima	1	0	1	0

The rostral is in contact with the internasal in about sixty-nine per cent of the specimens from Amami, about ten per cent of those from Kikaiga, and about five per cent of those from Okinawa. It is not in contact in either specimen from Miyako.

ROSTRAL AND INTERNASAL	In contact	Separated
Kikaiga (38 examined)	4	34
Amami Ō shima	29	13
Okinawa	1	17
Miyako	0	2

Neither of the specimens from Miyako shows any trace of the light lateral lines, even on the head. They are bright green above, and greenish white below and on the sides of the head. All of the other specimens from all the islands have very definite yellow lateral lines on the row of enlarged lateral scales, and this line extends the whole length of the body except in four specimens from Kikaiga (Nos. 21055, 21084, 21099, 21101) in which it covers only one-third or one-half the distance between the limbs, being absent posteriorly. There is considerable variation in the coloration of individual specimens from the northern islands. The entire area above the yellow lateral line may be bright green (turning in alcohol to blue and then to brownish or grayish slate); or the back may

be green, while the sides and tail are a beautiful bronze or yellowish brown. In some young specimens this bronze extends over the entire back. A few specimens have a second definite light line on the two outer rows of large dorsal scales. These lines may be yellow, a beautiful light green, or bronze. The lower surfaces are greenish white often becoming yellow on the limbs and tail.

The differences between the lizards of the various islands may be summarized as follows:

a.—Ventrals increased in number to more than six rows. No lateral light line. Dorsals tending toward reduction in number.
Miyako shima.

a².—Ventral rows of large scales not more than six. A light lateral line. Dorsals tending toward an increase in number.

- b.—Usually two preanals.
  Okinawa shima.
- b².—Usually one preanal.
  - c.—Rostral usually in contact with internasal.
    Amami Ō shima.
  - c².—Rostral usually not in contact with internasal.
    Kikaiga shima.

Dr. Boulenger described the species from numerous specimens labeled merely Loo Choo Islands, but his statement that there are eight rows of large ventrals would incline one to believe that he must have had lizards from Miyako. He describes them, however, as having the pale yellow lateral lines. On the other hand Dr. Stejneger had a specimen from Miyako which he states has only six rows of ventrals.

It seems, therefore, that we have here a single species occupying an extensive group of islands, and that upon each of these islands differentiation has begun but is still so slight as to be recognizable as an average difference only when large series are examined—the earliest tangible stage in the evolution of new species. Corresponding with its greater geographical separation, the lizards of Miyako seem to differ more from the lizards of the more northern islands than the latter do one from another. This probably indicates that Kikaiga shima, Amami Ō shima and Okinawa shima were united for some considerable time after their separation from Miyako shima.

The question arises whether or not it is advisable to recognize in nomenclature such slight differences as occur in these lizards. Doubtless there is room for difference of opinion,

but, if a name be merely a convenient handle for certain facts, it would seem that convenience might best be subserved by regarding the lizard of Miyako as the typical form and the northern lizards at subspecies designated by trinomials. I think, however, that such separation should await confirmation of the foregoing results by larger series from Miyako.

Takydromus sauteri Van Denburgh

This very distinct species is represented in the collection by more than fifty specimens from Koshun, Takao, and Kosempo, Formosa. The original description (Proc. Cal. Acad. Sci. (4), III, 1909, p. 50) was based upon a specimen from Koshun.

Diagnosis.—Dorsals large, in regular series; more than three pairs of postmentals; one inguinal pore on each side; ventrals keeled, in six longitudinal rows; head and tail elongate; color above bright green; lateral line on outer row of ventrals; lower surfaces white.

Type.—California Academy of Sciences, No. 18001. **Koshun, Formosa.**

Description of the type.—Rostral separated from the internasal by anterior nasals; nostril between anterior and posterior nasals, first labial, and rostral; two loreals, posterior larger, separated from the anterior large supraocular by a small plate; two large supraoculars in contact with frontal, separated from superciliaries by a row of granules; seven supralabials, the sixth largest, under eye; temporals moderate, keeled; the internasal, prefrontals, frontal, loreals, and supraoculars have along their posterior, and—in the case of the frontal and prefrontals—their lateral edges, a row of small tubercles which look like the heads of rivets; four pairs of postmentals; back with three or four rows of large keeled scales on each side, separated by two pairs of small keeled scales; laterals granular, except three rows of small keeled scales just above ventrals; ventrals strongly keeled, in six longitudinal and twenty-eight transverse rows; preanal single, large, with two keels, and with a much smaller keeled scale on each side; one inguinal pore on each side; limbs moderate, the hind limb carried forward reaches the elbow; tail about three and four-fifths times length of head and body, covered with carinate scales.

The color above is uniform bright green in fresh specimens, becoming blue or brown or slate in alcohol. A white line runs along the upper lip, passes through the lower corner of the ear-opening and is continued along the upper half of the outer row of large ventral plates to the base of the tail. The lower surfaces are white, without markings. The limbs are yellowish, unicolor.

Length to anus	53	mm.
Length of tail	202	"
Snout to ear-opening	12	"
Width of head	7	"
Fore limb	20	"
Hind limb	24	"
Base of fifth to end of fourth toe	11	"

Variation.—Fifty specimens have four pairs of postmentals. No. 18546 has three on one side and four on the other. No. 18550 has five pairs. All have but one inguinal pore on each side. All have six rows of large, keeled ventrals; usually (44 specimens) with two, rarely with no, one, or three, rows of lateral scales between the ventrals and the lateral granules. Fifty-one specimens have three rows of large dorsals on each side, separated usually by two rows anteriorly and one row posteriorly of smaller dorsals. These small dorsals may be 2-1-0, 3-2-1, one throughout, or 1-0. One specimen has the dorsal scales irregularly arranged, there being about one row of large scales on each side, separated by about seven rows of smaller scales. The supralabials may be either six or seven in number. Forty-one specimens have a single large preanal with two keels, three have this plate partially divided, six have it completely divided into two keeled scales, one has a single plate with four keels. The rostral is separated from the internasal in forty-nine specimens, and in contact with this plate in two. The tail varies from about three and one-half to nearly four times the length from snout to anus.

The coloring shows very little variation; but one specimen from Koshun (No. 18553) has a dark red-brown band along the side from the eye, just above the white line, to the tail, where it spreads over the upper surface. The white lateral line is quite constantly present.

This species is named for Mr. H. Sauter. It is very distinct from any of the known species of *Takydromus,* but probably is most closely related to *T. dorsalis.*

Takydromus kuehnei Van Denburgh

Diagnosis.—Dorsals large, in regular series; four pairs of postmentals; four or five inguinal pores on each side; ventrals in six longitudinal rows, the central four rows smooth; head elongate; color olive or olive brown above, with dark olive brown lateral band; lower surfaces white.

Type.—California Academy of Sciences, No. 18002. **Kanshirei, Formosa.**

Description of the type.—Rostral separated from the internasal by anterior nasals; nostril between anterior and posterior nasals (and some-

times first labial); two loreals, posterior much larger, separated from the anterior large supraocular by a small plate; two large supraoculars, in contact with frontal, anterior in contact with first superciliary, posterior separated from superciliaries by a row of granules; seven supralabials, sixth very large, under eye; temporals moderate, keeled; four pairs of postmentals; back with three rows of large, keeled scales, on each side, those of inner row largest, separated anteriorly by one row of smaller keeled scales. Behind the level of the elbows this row is wanting, or is represented only by an occasional scale, the large rows of the two sides being in contact; a few of the upper and lower series of lateral granules are enlarged and keeled, and close to the large dorsals, and also adjoining the ventrals, are small keeled scales; ventals in six longitudinal series of which all but the outer one on each side are smooth; preanal single, large, smooth, with a much smaller plate on each side; five inguinal pores on each side; limbs moderate, the hind leg carried forward reaches the elbow; tail covered with strongly carinate scales.

The color above is greenish olive, becoming lighter yellowish olive on the limbs and tail. The sides are dark olive brown. A light line, edged above with dark brown, starts at the nostril, crosses the lower eyelid, the lower part of the ear-opening and fades away above the axilla. The upper labials, dorsals, limbs and tail are dotted or spotted with dark brown. The lower surfaces are greenish white, tinged with orange on the tail.

Length to anus	59 mm.
Length of tail (reproduced)	130 "
Snout to ear-opening	14 "
Width of head	8 "
Fore limb	22 "
Hind limb	30 "
Base of fifth to end of fourth toe	13 "

Variation.—The thirteen specimens all have four pairs of postmentals. Eight have four inguinal pores on each side; one (No. 18564) has four on one side and five on the other; and four have five on each side. The large dorsals are in three rows on each side in all but No. 18436, which has four. The large dorsals of the two sides are separated anteriorly by one row of small scales, but in nine specimens this is lacking on the posterior part of the back. The supralabials usually are six, but may be 6-7 or 7-7. The ventrals are in six rows in all the specimens. The outer ventral row on each side is keeled in all except No. 18565, in which all are smooth. There sometimes is one row of enlarged laterals above the ventrals. The rostral is separated from the internasal in all. The preanal is smooth in all, and is single except in No. 18565, which has two smooth scales. The anterior supraocular may be in contact with the superciliary, or may be partially or completely separated by granules. The large dorsals of the inner rows are often marked centrally with very dark brown or black, and

these spots are sometimes continued on the tail as a single row of black spots along the mid-dorsal line on each alternate whorl of caudal scales.

This seems to be the rarest species of grass lizard in Formosa. It has been taken only at Kanshirei and Taipeh.

Achalinus werneri Van Denburgh

Diagnosis.—Similar to *Achalinus spinalis,* but with more numerous urosteges (88 to 96).

Type.—California Academy of Sciences, No. 22064. **Nase, Amami Ō shima, Loo Choo Islands, Japan.**

Description.—In general similar to *A. spinalis.* The internasal suture is about equal to that of the prefrontals. Loreals are absent. There is one preocular on each side. Temporals are 2+2+3 on each side. The supralabials are 6-6, the fourth and fifth reaching eye, the sixth largest. The sixth supralabial is semi-divided on one side. Infralabials are 6-6, the first in contact with its fellow of the opposite side, the first to fourth in contact with the anterior genials, the fifth and sixth largest. There are two pairs of genials, the posterior smaller. The scales are in twenty-three rows, with one keel except in the outer row, the scales of which are smooth and about twice the size of those above. The gastrosteges are one hundred and fifty-seven in number. The anal is entire. There are ninety-three undivided urosteges.

The back is nearly uniform dark brown, without definite dark lines. The lower surface of the tail is uniform dark brown like the back.

Length to anus	235 mm.
Length of tail	102 "

Variation.—A second specimen, No. 22091, agrees with the type in essential characters. It has scales in twenty-three rows, gastrosteges one hundred and seventy-two, anal entire, urosteges eighty-nine. The genials are two on one side and three on the other. The internasal suture is longer than the prefontal. The temporals are 2+2+3 and 2+2+4. There is a dark mid-dorsal line, and an indefinite dark subcaudal streak. The ventral surfaces are grayish white. The length to anus is 296 mm., of tail, 96 mm.

A tail 110 mm. long, taken from the stomach of a *Hemibungarus japonicus* (No. 22063) is now No. 22065 of the Academy's collection. It has ninety-six undivided urosteges.

Distribution.—This species has been taken only at Nase, Amami Ō shima, Loo Choo Islands, Japan.

Remarks.—This interesting new species differs from all other known species of the genus in having a greater number of gastrosteges. No *Achalinus* has heretofore been taken on any of the Loo Choo Islands, although species have been described from China, Formosa and Japan proper. I take pleasure in naming this snake for Dr. Franz Werner of Vienna.

Calliophis swinhoei Van Denburgh

Diagnosis.—Similar to *Calliophis macclellandii* but with more numerous gastrosteges and urosteges; the sum of the gastrosteges and urosteges always more than 256.

Type.—California Academy of Sciences, No. 14978. **Suishako, Central Formosa,** October 5, 1907.

Description of the type.—Eye about as long as distance from edge of lip. Rostral nearly as high as broad. Frontal as long as its distance from rostral, shorter than parietals. One pre- and two postoculars. Temporals 1+1. Supralabials seven, third and fourth reaching the eye, sixth and seventh largest. Infralabials six, first pair meeting behind the mental,* first four in contact with anterior genial, third and fourth largest. Anterior genials slightly larger than posterior. Scales in thirteen rows. Gastrosteges two hundred and thirty. Anal divided. Urosteges thirty-four, divided.

The color above is reddish brown, more grayish on the sides, crossed by thirty regular, narrow, light-edged black bars on the body and four on the tail. Many of the spaces between these bars show a small black spot on the third or fourth scale-row of each side. The black dorsal rings widen into blotches on the belly, and midway between these blotches are similar ventral blotches not connected with dorsal rings, but corresponding to the small lateral spots. The ground color of the belly is yellowish white. The snout, as far back as the anterior portions of the third supralabials, the preoculars, and the prefrontals, is gray. Behind this the head is black, crossed by a broad white band on the fifth, sixth, and seventh labials, the temporals, the posterior portions of the postoculars, supraocular, and frontal, and all but the extreme tip of the parietal plates.

Length to anus..............................	204 mm.
Length of tail..............................	20 "

Variation.—A second specimen in the Academy's collection No. 18864, has 219 gastrosteges, 41 urosteges, $29\frac{1}{2}$ dark dorsal rings on the body and 6 on the tail. In other respects it agrees with the type. In all, five specimens from Formosa are known. All have scales in thirteen rows, seven supra-

* This is not the case in the single Indian specimen at hand.

labials, and one pre- and two postoculars, anal divided, and temporals 1+1. The gastrostege and urostege counts are:

Museum	Gastrosteges	Urosteges	Sum	Authority	Locality
British	240	34	274	Boulenger	Formosa
Bureau Sci. Res	234	34	268	Oshima	Formosa
Taihoku Med. School	234	32	266	Oshima	Schinchiku, Formosa
Cal. Acad. Sci.	230	34	264		Suishako, Formosa
Cal. Acad. Sci.	219	41	260		Kosempo, Formosa

Twelve specimens of *C. macclellandii* from Continental Asia have counts as follows:

British	212	28	240	Boulenger	Assam
"	219	28	247	"	Pegu
"	215	26	241	"	Mts. N. Kiu Kiang
"	212	32	244	"	S. China
"	214	28	242	"	Nepal
"	231	25	256	"	Nepal
"	210	30	240	"	Darjeeling
"	210	30	240	"	Darjeeling
"	182	28	210	"	Darjeeling
"	193	36	229	"	Fokien, China
"	208	33	241	Günther	India
Cal. Acad Sci.					Sikkim, India

Distribution.—This snake seems to be restricted to the island of Formosa, where it has been taken at Shinchiku, Suishako and Kosempo. The continental species, *C. macclellandii,* has been found from India to Fokien, China.

This species is named for Robert Swinhoe who sent the first specimen to the British Museum.

Hemibungarus japonicus (Günther)

We have received four specimens of *Hemibungarus* from Amami Ō shima. Numbers 22063 and 22089 have only the middorsal black line without any indication of lateral lines. No. 22090 has, in addition to the central dorsal line which ends on the basal third of the tail, a few blackish dots along the adjacent borders of the third and fourth rows of scales. No. 14987 shows the midline and a narrow, though very distinct, trace of a lateral line on the third and fourth rows of scales. The blackish rings on the body are fourteen in two specimens, and thirteen in two; and two and three on the tail. No. 22063 has only twenty-seven urosteges; otherwise the scale-counts are within the known range of this form.

Cal. Ac. Sci. No.	Scales	Gastrosteges	Urosteges	Supralabials	Pre-Post Oculars	Temporals
14987	13	215	31	7-7	1-2	1+1
22063	13	202	27	7-7	1-2	1+1
22089	13	206	30	7-7	1-2	1+1
22090	13	205	30	7-7	1-2	1+1

Including those mentioned above, twelve specimens are known to have been taken on Amami Ō shima. Of these, six have only the median dorsal black line; five have a lateral line on the third and fourth row of scales of each side, more or less clearly indicated; one, examined by Dr. Wall, had indications of another line on each side, making five lines as in *H. boettgeri*, but much narrower and less intense.

No. 22063 contained the remains of an *Achalinus* (No. 22065) which it had eaten.

Hemibungarus boettgeri (Fritze)

We have received two specimens of this snake, but, unfortunately, neither bears an exact locality-label. Both were purchased in Kyoto, Japan, and one is labeled "Formosa?" while the other is from the Loo Choo Islands. The latter, No. 16470, has 221 gastrosteges, and eighteen dorsally complete black rings on the body with two on the tail. There can be no doubt that the specimen labeled "Formosa?" also came from the Loo Choos. It has two small maxillary teeth, 207 gastrosteges, 29 urosteges, 13 scale rows, and 13 body rings. The only difference between *Hemibungarus boettgeri* and *H. japonicus* is found in the number and character of the longitudinal black lines. Although it has been shown that *H. japonicus* may have either one, three or five lines, these lines seem always to be much narrower and less intense than in *H. boettgeri*. Thus far, all (ten) specimens of the *H. boettgeri* type of coloration which have any definite locality assigned, have been secured in Okinawa, while all the (twelve) definitely labeled *H. japonicus* have come from Amami Ō shima. It would seem, therefore, that the *Hemibungarus* of Okinawa is different from that of Amami Ō shima, and that they must be recognized as distinct species until more definitely intermediate specimens are discovered.

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NOTES ON ASCAPHUS, THE DISCOGLOSSOID TOAD OF NORTH AMERICA

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More than twelve years have passed since Dr. Stejneger[1] announced the discovery of a single specimen of a costate toad—the first representative of the *Discoglossidae* found anywhere in the Western Hemisphere. During these twelve years there has appeared no additional information regarding this extremely interesting toad; and there has been some room for suspicion that the original specimen might, in some way, have been brought over from the Old World. The finding of additional specimens, therefore, is a matter of much interest.

The type specimen described by Dr. Stejneger was caught by Mr. Cloud Rutter, August 19, 1897, near Humptulips, Chehalis County, Washington. This locality has an elevation of about 265 feet.

In 1905, my friend Dr. E. C. Van Dyke visited Mt. Rainier, in the Mt. Rainier National Park in the eastern part of Pierce County, Washington, and, between July 15 and 31, collected for me five specimens of amphibians. These were one *Rana pretiosa,* one *Ambystoma macrodactylum,* one *Chondrotus paroticus,* the unique type of *Plethodon vandykei,* and a single specimen of *Ascaphus truei.* Unfortunately, all these specimens were destroyed in the great San Francisco fire of

[1]Proc. U. S. Nat. Mus., XXI, 1899, pp. 899-901, pl. LXXXIX.

December 20, 1912

April, 1906. The *Ascaphus* was secured on the southeast side of Mt. Rainier, in the vicinity of Reflection Lake, at an altitude of about 4861 feet.

In 1911, it became possible to send Mr. Slevin on a collecting trip through western California, Oregon, and Washington, and I requested him to look most carefully for *Ascaphus* both at Humptulips and on Mt. Rainier. At Humptulips, late in July, he was unsuccessful, but on Mt. Rainier, in the middle of August, he secured three specimens of this toad. He has given me the following notes regarding their capture:

"On August 16 and 17, I took three specimens of *Ascaphus* on the southwest side of Mt. Rainier, in what is known as Indian Henry's Hunting Grounds, at about 6000 ft. elevation. All three were found on bright sunny mornings between 10:30 and noon, in a small slow-flowing stream. The one first taken jumped out of the brush into a small pool about four feet wide, five or six feet long, and two or three feet deep. It swam for a few seconds, just as a toad does; and when I attempted to catch it with my forceps, it went to the bottom and settled just like a frog—remaining perfectly motionless, its color blending with the color of the rocks and earth at the bottom of the pool. The second one I noticed in the same place, and I first saw him swimming about the middle of the pool just as I stepped down on the bank. While I was attempting to capture this specimen a third one jumped into the pool from the bank directly opposite me and went straight to the bottom. I collected both of these specimens, but a careful search and beating of brush in the vicinity failed to discover any more. All three specimens were kept in a tin can, well punctured for ventilation, but they died within ten or twelve hours after capture."

These specimens are now numbers 30393, 30394 and 30395 of the Academy's collection. All appear to be adult males with enlarged testes and very large pads on the inner surface of the carpus. They measure from snout to anus: (No. 30394) 40 mm., (No. 30393) 41 mm., and (No. 30395) 42 mm.

The skin is nearly smooth in No. 30395, which has only a few warts over the pelvis and femur; but is moderately rough in No. 30394, which has warts or small tubercles scattered over the entire upper surface and sides of the head and body, and the upper surface of the arm, thigh, and leg. The para-

toid gland is not strongly developed, but may be made out as a glandular postocular ridge descending along the side of the neck.

By far the most remarkable external feature of these toads is the *tail!* This is well-developed in the three specimens at hand, and was present also in the one collected by Dr. Van Dyke (No. 6907). It extends back from six to eight millimeters from the posterior surface of the thighs, is about four millimeters wide, and about three and a half deep at its base. The cloaca is continued from its usual position into this structure, and ends in a large, swollen orifice just in front and below the tip of the "tail." This structure, at first glance, suggests that the specimens were but recently transformed, but the ossification of the skeleton and the development of the testes show that they are adult. It is possible that this "tail" may be a sexual organ.

The pupil is vertical. No tympanum can be distinguished. The small round patches of vomerine teeth are between the anterior part or middle of the choanae, and are about equidistant from the internal edges of these openings and from each other. The tongue is very broadly attached, but is slightly free all around its edge.

The hind foot has one rounded tubercle at the base of the first toe. On the lower surface of the carpus are three pads—a very large inner one, and a small one on the base of each of the two outer metacarpals.

The coloration is dull grayish or brownish slate above, with a light gray band, bordered behind with blackish brown, crossing the head over the anterior halves of the upper eyelids. There is a blackish streak from the snout to the eye and from the eye along the paratoid. Some irregular black markings may be made out on the sides, back, and limbs, with a tendency to form longitudinal streaks. The "tail" has a light dorsal stripe, bordered on each side by dark brown streaks. Most of the warts are lighter than the ground color. The lower surfaces are yellowish white clouded with slate. There is a row of white dots along the rim of the lower jaw.

No. 30393, which was intermediate in size and roughness of skin, has been prepared as a skeleton. The following notes were made before this was done, and the skin has been pre-

served. The heels cross by the width of the tarsus. The extended heel reaches the anterior border of the eye. The limb tubercles, web, paratoid, etc., are as in No. 30394. Measurements are:

Snout to anus	41. mm.
Snout to base of "tail"	37. "
"Tail"	8. "
Width of head	13.5 "
Hind limb	52. "
Heel to tip of longest toe	23. "

There are *ten* vertebrae, of which the first is the atlas and the tenth the sacrum. The vertebrae are opisthocoelous. The first vertebra has no diapophyses. All the other vertebrae have diapophyses, those of the fifth being shortest. The extreme widths of the vertebrae and lengths of ventral surface of centra are:

1 vertebra	2.5	mm. wide,	1.5	long
2 "	4.25	"	.9	"
3 "	4.25	"	1.	"
4 "	4.75	"	1.1	"
5 "	3.6	"	1.2	"
6 "	4.2	"	1.25	"
7 "	4.	"	1.4	"
8 "	4.	"	1.5	"
9 "	4.	"	1.5	"
10 "	6.	"	.8	"

The sacral diapophyses increase in breadth from .7 to 1.5 mm.

The coccyx is subcylindrical, with a dorsal ridge. It is 8.4 mm. long, .7 mm. in diameter near the middle, and 1 mm. at the ends. A pair of small diapophyses increase its breadth near the sacrum to 2.1 mm.

The diapophyses of the second, third, and fourth vertebrae bear short ribs. The ribs attached to the third vertebra are longest, measuring 1.5 mm. Those on the second vertebra are .75 mm. long; while those of the fourth vertebra are only about .25 mm. in length.

The skull is 12 mm. long, and 12 mm. wide. It articulates with the atlas by means of two condyles, which are about twice as broad as high, are borne by the exoccipital, and border the foramen magnum inferiorly. The fronto-parietals are 7 mm. long, narrow, well ossified, and completely separated by a

fontanelle. The prefrontals are fairly large, and touch the fronto-parietals. The quadrate is rather small. The squamosal and pterygoid are well-developed. The inner process of the pterygoid reaches the anterior surface of the auditory capsule, while the anterior process passes forward with the maxilla to meet the palatine. The parasphenoid extends forward anterior to the palatines; its lateral processes are well-developed, and reach nearly to the border of the large foramina in the auditory capsules. These capsules extend laterally 3.5 mm. from the mid-line of the skull; each displays at the posterior and inferior aspect of its lateral portion a foramen 1 mm. in diameter, covered by a delicate membrane, the fenestra ovalis. The membrane, however, may be heavily covered with a deposit of the chalky material which is found in the cavity of the auditory capsule. I have not found any evidence of eustachian tubes. The lower jaw is entirely without teeth. The upper jaw bears a series of very small teeth. There are two small rounded patches of vomerine teeth.

The shoulder girdle is arciferous, the right side lying on the ventral surface of the left. The clavicles are well ossified, but little curved, and meet medially. There appears to be no omosternum. The coracoids are rather short (3 mm.) with expanded ends. The precoracoid cartilages are narrow, but the epicoracoid expansions are very broad. The scapula is rather small, completely ossified, and broadly fused with the clavicle. The suprascapula is composed of two portions: an anterior bony bar 4.5 by 1 mm., narrowing to .6 mm. at its middle; and a broad cartilaginous plate, 5.5 by 4 mm. in greatest dimensions, bordering the bony bar above and posteriorly.

The metasternum has been injured in preparing the specimen, but it appears to have been a simple transverse bar of cartilage.

The humerus is 10.5 mm. long. It bears a very strong proximal crest, and the condyloid ridges are so largely developed that the breadth of the humerus in this region is 3 mm., while in the middle of the shaft it is only 1 mm.

The radius and ulna are completely fused into a single bone 7 mm. long.

The carpus is composed of an ulnare, a radiale, a radial and an ulnar centrale, and four distal carpals.

There are four well-developed metacarpals, of which the external one articulates with the ulnar centrale, while the others are borne by the distal carpalia.

The four digits are made up of 2, 2, 3, and 3 straight phalanges. The terminal phalanges taper to rounded ends.

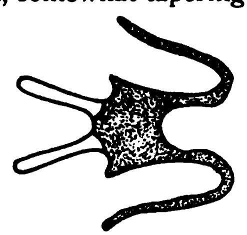
The ilia are very slender. They measure 9.5 mm. long, .7 mm. wide and .5 mm. thick. The posterior end of the ilium is much enlarged, and forms about the anterior upper half of the acetabulum, the remainder being supplied by the ischium. The acetabulum is not completely closed. At the interior and ventral aspect of the pelvis, at the lower margin of the sutures between the ilia and ischia, are two thin plates of calcified cartilage about 1.5 mm. in diameter, which probably represent the pubes.

The femur is very slender. Its length is 15 mm., and its least diameter is 1 mm. It bears a strong proximal keel.

The tibio-fibula is 16.5 mm. long by .9 mm. in diameter near its center, but broadens at the ends to 2.4 mm.

The tarsus is formed of the usual proximal and distal portions. The former comprises the astragalus and calcaneum, about 9 mm. long, which are fused for a distance of 2 mm. proximally and 1 mm. distally. These bones are quite slender. The more distal tarsal bones are four in number—one at the end of the astragalus, one bearing the same relation to the calcaneum, a smaller one between these, and a still smaller one at the base of the first metatarsal.

There are five metatarsals corresponding to the five toes. Beginning with the inner one, the toes are composed of 2, 2, 3, 4, and 3 straight, somewhat tapering phalanges.



The hyoid is well developed, has long anterior processes, and is shaped as shown in the accompanying cut.

The alimentary canal of this specimen contained a small bright red spider and the remains of two beetles of different species.

PROCEEDINGS

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A DISTRIBUTIONAL LIST OF THE MAMMALS OF CALIFORNIA

BY JOSEPH GRINNELL

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The compilation of the following list of the mammals of California has proved well worth while as a help in work with the collections in the California Museum of Vertebrate Zoology. It is believed that its publication now will find justification in its resulting usefulness in other ways—wherever, in fact, a clue to the described species is desired. The literature of the subject is widely scattered, and an index to it, so far as California is concerned, has been practically wanting. The present contribution is intended to meet, in part at least, this need.

It must be urged upon the casual enquirer that, at the present stage in the systematic study of California mammals, the status of the various forms as here given can in scarcely any case be accepted as final. Only a few genera have been given critical study upon the basis of material at all satisfactory. Osgood's *Revision of the Mice of the American Genus Peromyscus* (1909) may be cited as the best example of such monographic treatment. Not until each group has been subjected to similar analysis, and especially so with regard to limited areas such as that comprised within the state of California, can the status and distribution of the more slightly differentiated forms be considered as satisfactorily established.

In including species and subspecies, the writer has in the great majority of cases followed the conclusions of the original describers. Where genera have been formally revised, the de-

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cisions of the reviser have been accepted. This has been the rule; but in a few instances, where the material at hand has seemed adequate, and where a sufficient amount of study has been accorded it to warrant, as it might seem, an independent opinion, this has been offered. Thus certain current names will be found synonymized, and other names not generally recognized are given full standing.

It is quite probable that to the present list a number of forms are admitted, which subsequent collections and studies will show to be untenable. This is particularly likely in the Heteromyidae. On the other hand, there doubtless remain many species and subspecies yet to be discovered and named; so that in time the total number of mammals known to belong to California is likely to remain undiminished.

The point to be emphasized is that, both as regards the standing of the species of our region, and as regards their distribution, systematic mammalogy is in a formative stage. A very great amount of field-work and critical study must be done to bring mammalogy to the plane already reached in ornithology.

The system of entry adopted in the following list is simple. Of the higher groups only Orders and Families are given. The scientific name here adopted for the species is given in boldface, followed by the authority. A vernacular name has been selected—in many cases with difficulty, as is admitted. In nearly every case the "original description" has been verified from its original source. In the few instances where the citation is given within quotation marks, the citation is at second-hand, that is, the original has not been seen by the writer.

The type locality is usually just as given in connection with the original description; sometimes it is modified somewhat to make it more intelligible, for example, by giving the name of the county or of the nearest large town; and occasionally corrections have been necessary.

The "synonyms" are any other names—aside from those appearing in the heading and in the citation following "original description"—that have been applied to the species *as occurring within the state of California*. Where a name now considered synonymous with the accepted one, was based upon a specimen *from California*, the full citation and type locality are given.

The "range" of each species is given briefly, but as accurately as our present state of zoogeographical knowledge makes possible. In the case of land mammals, ranges are stated, wherever practicable, in terms of life-zones and faunal areas. Exact localities are named only where they are believed to mark points somewhere near the extreme limits of distribution. Authorities for the information included in the statement of range are always given whenever precise data of any sort are available. In all cases where the abbreviation "Mus. Vert. Zool." appears, specimens indicating the stated range, either entirely or in part, are contained in the California Museum of Vertebrate Zoology.

The accompanying map of the life-zones of the state has been compiled primarily from data on file in the California Museum of Vertebrate Zoology. Use has been made also of information from many published botanical papers. Professor Harvey M. Hall of the University of California has kindly made a number of corrections based upon his knowledge of plant-distribution in the state. It is almost superfluous to state here that the employment of the life-zone concept in defining ranges of animals as well as of plants, owes its beginning to the researches of the foremost mammalogist of America, C. Hart Merriam. It is a matter of credit to him that the farther we carry our studies in distribution, the more they align themselves in support of the laws formulated by him.

The map of the faunal districts of the state is offered not at all as a final exposition of this order of distributional behavior, but as a help in designating the ranges of the mammals. The boundaries as given are of course merely approximate; and even the areas themselves, as here outlined, will doubtless receive extensive modification on the basis of further geographical study.

The present list was concluded to date, in August, 1912. Since then appeared Gerrit S. Miller's important *List of North American Land Mammals in the United States National Museum, 1911* (published December 31, 1912). The writer thereupon changed the order in the California list to accord with Miller's, and also made a number of changes in generic and family names in accordance with some of the decisions of the same authority.

The writer here wishes to express his appreciation of the cordial assistance rendered in various ways by Mr. John Rowley, Curator of Mammals in the California Academy of Sciences. Acknowledgments are also due Mr. Walter P. Taylor, of the staff of the California Museum of Vertebrate Zoology, for correcting several errors in the manuscript.

To summarize: according to the present enumeration 337 species of mammals are accredited to California and the adjacent ocean. Eight Orders are represented, thirty-one Families, and eighty-nine Genera.

Order INSECTIVORA

Family TALPIDAE

Scapanus townsendi (Bachman)

Oregon Mole

Original description—*Scalops townsendii* Bachman, Journ. Acad. Nat. Sci. Phila., **8**, pt. 1, 1839, pp. 58–60.

Type locality—Fort Vancouver, Clarke County, Washington (*fide* True, Proc. U. S. Nat. Mus., **19**, 1896, p. 63).

Synonym—Townsend Mole.

Range—Boreal and Transition zones in extreme northern humid coast belt, south to Cuddeback, Humboldt County (Mus. Vert. Zool.).

Scapanus orarius True

Northwest Coast Mole

Original description—*Scapanus orarius* True, Proc. U. S. Nat. Mus., **19**, December, 1896, p. 52.

Type locality—Shoalwater Bay, Pacific County, Washington.

Range—Boreal and Transition zones in extreme northern humid coast belt, south as far as Cuddeback, Humboldt County (Mus. Vert. Zool.), and Mendocino, Mendocino County (Elliot, Field Col. Mus., zool. ser., **3**, 1903, p. 197).

Scapanus latimanus latimanus (Bachman)

Central California Mole

Original description—*Scalops latimanus* Bachman, Boston Journ. Nat. Hist., **4**, January, 1842, pp. 34, 35.

Type locality—Probably Santa Clara, Santa Clara County, California (*fide* Osgood, Proc. Biol. Soc. Wash., **20**, 1907, p. 52).

Synonyms—*Scalops californicus* Ayres, Proc. Calif. Acad. Sci., **1**, 1855, p. 54 (type from San Francisco, California); *Scapanus californicus*, part; *Scapanus townsendi*, part; *Scapanus californicus minusculus* Bangs, Proc. New Eng. Zool. Club, **1**, July 31, 1899, p. 70 (type from Fyffe, Eldorado County, California); Broad-palmed Shrew-mole.

Range—Upper Sonoran and Transition zones of west-central California, east to include the Sierra Nevada and as far as Independence, Inyo County, north to Shasta County, south to San Luis Obispo County (Mus. Vert. Zool.).

Scapanus latimanus occultus Grinnell and Swarth

Southern California Mole

Original description—*Scapanus latimanus occultus* Grinnell and Swarth, Univ. Calif. Publ. Zool., **10**, April 13, 1912, p. 131.

Type locality—Santa Ana Canyon, 400 feet altitude, Orange County, California.

Synonyms—*Scapanus californicus*, part; *Scapanus latimanus*, part; *Scapanus anthonyi; Scapanus californicus anthonyi;* Anthony Mole.

Range—Southern California, west of the desert divides, south of the 35th parallel, hence chiefly in the San Diegan district; ranges from Lower Sonoran zone to Boreal (Mus. Vert. Zool.).

Scapanus latimanus truei Merriam

Modoc Mole

Original description—*Scapanus truei* Merriam, Proc. Biol. Soc. Wash., **11**, April 26, 1897, p. 102.

Type locality—Lake City, Modoc County, California.

Synonym—*Scapanus californicus truei.*

Range—Upper Sonoran and Transition zones in the Modoc region of northeastern California, east at least as far as Sisson, Siskiyou County (Mus. Vert. Zool.).

Neurotrichus gibbsi major Merriam

Large Shrew-Mole

Original description—*Neurotrichus gibbsi major* Merriam, N. Amer. Fauna, **16**, October 28, 1899, p. 88.

Type locality—Carberry Ranch, 4100 feet altitude, between Mount Shasta and Mount Lassen, Shasta County, California.

Synonyms—*Neurotrichus gibbsi,* part; Gibbs Mole, part.

Range—High Transition and Boreal zones on Mount Shasta, and at the type locality, as above (Merriam, *supra cit.*).

Neurotrichus gibbsi hyacinthinus Bangs

California Shrew-Mole

Original description—*Neurotrichus gibbsi hyacinthinus* Bangs, Amer. Nat., **31**, March, 1897, pp. 240, 241.

Type locality—Nicasio, Marin County, California.

Synonyms—*Neurotrichus gibbsi,* part; Hyacinthine Shrew-Mole; Gibbs Mole, part.

Range—Transition and Boreal zones in the northwest humid coast belt from the Humboldt Bay region south as far as Santa Cruz, Santa Cruz County, and Portola, San Mateo County (Mus. Vert. Zool.; Allen, Bull. Amer. Mus. Nat. Hist., **8**, 1896, p. 269).

Family SORICIDAE

Sorex vagrans vagrans Baird

Wandering Shrew

Original description—*Sorex vagrans* (Cooper MS) Baird, Pac. R. R. Rep., **8**, 1857, pp. 15-18, pl. 18, figs. 5, 6.

Type locality—Shoalwater Bay, Pacific County, Washington.

Range—Upper Sonoran, Transition and Boreal zones in the northwestern portion of the state, east to Shasta County, and south as far as Monterey (Merriam, N. Amer. Fauna, **10**, 1895, p. 68; Mus. Vert. Zool.).

Sorex vagrans amoenus Merriam

Sierra Nevada Shrew

Original description—*Sorex amoenus* Merriam, N. Amer. Fauna, **10**, December, 1895, pp. 69, 70.

Type locality—Mammoth Pass, 10,000 feet altitude, east slope Sierra Nevada, Mono County, California.

Range—Transition and Boreal zones on the Sierra Nevada, at least from Mono County north to Mount Shasta (Merriam, *supra cit.*, and N. Amer. Fauna, **16**, 1899, p. 87; Mus. Vert. Zool.).

Sorex halicoetes Grinnell

Salt Marsh Shrew

Original description—*Sorex halicoetes* Grinnell, Univ. Calif. Publ. Zool., **10**, March 20, 1913, pp. 181-184.

Type locality—Salt Marsh near Palo Alto, Santa Clara County, California.

Range—Salt marshes bordering the south arm of San Francisco Bay, at least from Belmont, San Mateo County, around to Melrose, Alameda County (Mus. Vert. Zool.).

Sorex obscurus obscurus Merriam

Dusky Shrew

Original description—*Sorex obscurus* Merriam, N. Amer. Fauna, **10**, December, 1895, pp. 72, 73.

Type locality—Timber Creek, 8200 feet, Salmon River Mountains, Idaho (see Merriam, N. Amer. Fauna, **5**, 1891, p. 34).

Range—Boreal zone along the Sierra Nevada, from Shasta County to Olancha Peak, Tulare County (Merriam, *supra cit.*; Mus. Vert. Zool.).

Sorex montereyensis montereyensis Merriam

Monterey Shrew

Original description—Sorex montereyensis Merriam, N. Amer. Fauna, **10**, December, 1895, p. 79.

Type locality—Monterey, Monterey County, California.

Range—Transition and Upper Sonoran zones in the northern and central coast districts, from the Oregon line south as far as Morro, San Luis Obispo County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Sorex montereyensis mariposae Grinnell

Yosemite Shrew

Original description—Sorex montereyensis mariposae Grinnell, Univ. Calif. Publ. Zool., **10**, March 20, 1913, pp. 189, 190.

Type locality—Yosemite Valley at 4000 feet altitude, Mariposa County, California.

Synonyms—Sorex montereyensis, part; Monterey Shrew, part.

Range—Transition zone along west slope of Sierra Navada, at least from Siskiyou County to Tulare County; also on the Warner Mountains, Modoc County (Mus. Vert. Zool.; Merriam, N. Amer. Fauna, **10**, 1895, p. 79).

Sorex ornatus Merriam

Adorned Shrew

Original description—Sorex ornatus Merriam, N. Amer. Fauna, **10**, December, 1895, pp. 79, 80.

Type locality—San Emigdio Canyon, Mount Pinos, in Kern County, California.

Range—Upper Sonoran and Transition zones in the San Diegan district and included mountain ranges, from the Mexican line northwest to Mount Pinos and Fort Tejon, in Ventura and Kern counties (Merriam, *supra cit.;* Mus. Vert. Zool.).

Sorex californicus californicus Merriam

California Shrew

Original description—Sorex californicus Merriam, N. Amer. Fauna, **10**, December, 1895, pp. 80, 81.

Type locality—Walnut Creek, Contra Costa County, California.

Range—Upper Sonoran zone of west-central California along inner coast ranges and in the vicinity of San Francisco Bay, north to Rumsey, Yolo County, east to Byron, Contra Costa County, and south to near Los Baños, Merced County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Sorex sinuosus Grinnell

Suisun Shrew

Original description—*Sorex sinuosus* Grinnell, Univ. Calif. Publ. Zool., **10**, March 20, 1913, pp. 181, 187.

Type locality—Grizzly Island, near Suisun, Solano County, California.

Range—Brackish marshes of Grizzly Island, Suisun Bay, Solano County (Mus. Vert. Zool.).

Sorex shastensis Merriam

Shasta Shrew

Original description—*Sorex shastensis* Merriam, N. Amer. Fauna, **16**, October 28, 1899, p. 87.

Type locality—Wagon Camp, 5700 feet altitude, Mount Shasta, Siskiyou County, California.

Range—Boreal zone of Mount Shasta; only the type, as above, recorded.

Sorex tenellus tenellus Merriam

Inyo Shrew

Original description—*Sorex tenellus* Merriam, N. Amer. Fauna, **10**, December, 1895, p. 81.

Type locality—Summit of Alabama Hills near Lone Pine, Owens Valley, Inyo County, California.

Range—Known only from the type locality, as above.

Sorex tenellus lyelli Merriam

Mount Lyell Shrew

Original description—*Sorex tenellus lyelli* Merriam, Proc. Biol. Soc. Wash., **15**, March 22, 1902, p. 75.

Type locality—Mount Lyell, Tuolumne County, California.

Range—Known only from the type locality, as above.

Sorex tenellus myops Merriam

White Mountains Shrew

Original description—*Sorex tenellus myops* Merriam, Proc. Biol. Soc. Wash., **15**, March 22, 1902, p. 76.

Type locality—White Mountains, Inyo County, California.

Range—Known only from the type locality, as above.

Sorex pacificus Baird

Pacific Shrew

Original description—*Sorex pacificus* Baird, *in* Coues, Bull. U. S. Geol. and Geog. Surv. Terr., **3**, 1877, p. 650.

Type locality—Fort Umpqua, mouth of Umpqua River, Douglas County, Oregon.

Range—Transition and Boreal zones in the northwest humid coast belt: Humboldt Bay region and south as far as Point Reyes, Marin County (Merriam, N. Amer. Fauna, **10**, 1895, p. 87; Mus. Vert. Zool.).

Neosorex palustris navigator Baird

Navigator Shrew

Original description—*Neosorex navigator* (Cooper, MS) Baird, Pac. R. R. Rep., **8**, 1857, pp. 11, 12, pl. 26.

Type locality—Unknown; possibly northern Idaho (*fide* Merriam, N. Amer. Fauna, **10**, 1895, p. 92).

Synonyms—*Sorex palustris navigator;* Water Shrew.

Range—Chiefly in the Boreal zone, on the Sierra Nevada, from Whitney Meadows, Tulare County, north to Mount Shasta, and on the Warner Mountains, Modoc County (Mus. Vert. Zool.).

Neosorex bendirei bendirei (Merriam)

Bendire Shrew

Original description—"*Atophyrax bendirii* Merriam, Trans. Linn. Soc. New York, **2**, August, 1884, pp. 217–225."

Type locality—Near Williamson River, 18 miles southeast of Fort Klamath, Klamath County, Oregon (*fide* Merriam, N. Amer. Fauna, **10**, 1895, pp. 95–97).

Synonym—*Sorex bendirei.*

Range—Transition and Boreal zones in the humid northwest coast belt: Humboldt Bay region south to Gualala, Mendocino County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Notiosorex crawfordi crawfordi Baird

Desert Shrew

Original description—*Sorex (Notiosorex) crawfordi* Baird, *in* Coues, Bull. U. S. Geol. and Geog. Surv. Terr., **3**, 1877, pp. 651, 652.

Type locality—El Paso, Texas (*fide* Merriam, N. Amer. Fauna, **10**, 1895, p. 32).

Synonyms—Crawford Shrew; Gray Shrew; *Sorex crawfordi.*

Range—Lower Sonoran zone in the San Diegan district, from the Mexican line north at least to San Bernardino and Colton (Stephens, Calif. Mammals, 1906, p. 255; Mus. Vert. Zool.).

Order CHIROPTERA

Family PHYLLOSTOMIDAE

Macrotus californicus Baird

California Leaf-nosed Bat

Original description—*Macrotus californicus* Baird, Proc. Acad. Nat. Sci. Phila., May, 1858, pp. 116, 117.

Type locality—Fort Yuma, Imperial County, California.

Synonyms—*Macrotus waterhousei; Otopterus californicus.*

Range—Lower Sonoran zone on the Colorado desert, northwest to near Torres, Riverside County (Mus. Vert. Zool.). Apparently absent during midwinter (see Stephens, Calif. Mammals, 1906, pp. 276, 277).

Family VESPERTILIONIDAE

Myotis velifer (J. A. Allen)

Cave Bat

Original description—*Vespertilio velifer* Allen, Bull. Amer. Mus. Nat. Hist., **3**, December, 1890, p. 177.

Type locality—Santa Cruz del Valle, Guadalajara, Jalisco, Mexico.

Range—Lower Sonoran zone near Colorado River: Needles, San Bernardino County (Mus. Vert. Zool.).

Myotis occultus Hollister

Hollister Bat

Original description—*Myotis occultus* Hollister, Proc. Biol. Soc. Wash., **22**, March 10, 1909, pp. 43, 44.

Type locality—West side of Colorado River ten miles above Needles, San Bernardino County, California.

Range—Lower Sonoran zone: valley of the Colorado River from near Needles (as above) to near Yuma (Mus. Vert. Zool.).

Myotis lucifugus longicrus (True)

Long-legged Bat

Original description—*Vespertilio longicrus* True, Science, **8**, December 24, 1886, p. 588.

Type locality—Puget Sound, Washington.

Synonyms—*Vespertilio albescens,* part; True Bat; Long-shanked Bat.

Range—Transition and high Upper Sonoran zones throughout northern California and south along the Sierra Nevada and coast ranges to the San Jacinto and Cuyamaca mountains (Mus. Vert. Zool.; Miller, N. Amer. Fauna, **13**, 1897, p. 65).

Myotis yumanensis yumanensis (H. Allen)

Yuma Bat

Original description—*Vespertilio yumanensis* H. Allen, Smithsonian Misc. Coll., **7**, June, 1864, p. 58.

Type locality—Fort Yuma, Imperial County, California.
Synonym—*Vespertilio albescens,* part.
Range—Lower and Upper Sonoran zones throughout southern California, both east and west of the desert divides; north through Owens Valley and through the San Joaquin and Sacramento valleys at least as far as Oroville, Butte County (Mus. Vert. Zool.; Miller, N. Amer. Fauna, 13, 1897, p. 67). Probably migratory.

Myotis yumanensis saturatus Miller

Miller Bat

Original description—*Myotis yumanensis saturatus* Miller, N. Amer. Fauna, 13, October, 1897, p. 68.
Type locality—Hamilton, Skagit County, Washington.
Range—Transition and Boreal zones in extreme northwestern California, west to Cuddeback, Humboldt County (Mus. Vert. Zool.), east to Mount Shasta (Merriam, N. Amer. Fauna, 16, 1899, p. 89).

Myotis californicus californicus (Audubon and Bachman)

Little California Bat

Original description—*Vespertilio californicus* Audubon and Bachman, Journ. Acad. Nat. Sci. Phila., 8, 1842, pp. 285, 286.
Type locality—California.
Synonyms—*Vespertilio oregonensis* (?); *Vespertilio nitidus* H. Allen, Proc. Acad. Nat. Sci. Phila., April, 1862, pp. 247, 248 (type from Monterey); *Vespertilio albescens melanorhinus.*
Range—Upper Sonoran and Transition zones almost throughout the state west of the desert divides, including the San Diegan district, the Santa Barbara Islands, and both the Sierra Nevada and coast ranges.

Myotis californicus pallidus Stephens

Stephens Little Pallid Bat

Original description—*Myotis californicus pallidus* Stephens, Proc. Biol. Soc. Wash., 13, June 13, 1900, p. 153.
Type locality—Vallecito, eastern San Diego County, California.

Synonym—Myotis californicus, part.

Range—Lower Sonoran zone on Colorado and Mohave deserts, north to Owens Valley (Mus. Vert. Zool.). It is not improbable that the above name will have to be replaced by some one of H. Allen's earlier names.

Myotis orinomus Elliot

La Grulla Brown Bat

Original description—Myotis orinomus Elliot, Field Col. Mus., zool. ser., **3**, June, 1903, p. 228.

Type locality—La Grulla, 8000 feet, San Pedro Martir Mountains, Lower California, Mexico.

Synonyms—Myotis californicus, part; *Myotis lucifugus longicrus,* part.

Range—High Upper Sonoran zone, in its semi-arid portion, along the southern Sierra Nevada in Kern and Inyo counties, in the San Jacinto and San Bernardino mountains, and at Dulzura, San Diego County (Grinnell and Swarth, Univ. Calif. Publ. Zool., **10**, 1912, pp. 138-141).

Myotis evotis (H. Allen)

Long-eared Bat

Original description—Vespertilio evotis H. Allen, Smithsonian Misc. Coll., **7**, June, 1864, p. 48.

Type locality—Monterey, California (see Miller, N. Amer. Fauna, **13**, 1897, pp. 77, 78).

Synonym—Vespertilio albescens evotis, part.

Range—Upper Sonoran and Transition zones from the Mexican line northwards as far as Mount Shasta; west to Pescadero Creek, San Mateo County; east to Independence Lake, Nevada County (Mus. Vert. Zool.); also Owens Lake and Inyo Mountains (Miller, *supra cit.,* p. 80).

Myotis thysanodes Miller

Fringed Bat

Original description—Myotis thysonodes Miller, N. Amer. Fauna, **13**, October, 1897, pp. 80-84.

Type locality—Fort Tejon, Kern County, California.

Synonyms—*Vespertilio albescens velifer,* part; *Vespertilio albescens evotis,* part.

Range—Upper Sonoran zone in southern California near the desert divide; known only from Fort Tejon, Kern County, and Dulzura, San Diego County (Miller, *supra cit.*).

Lasionycteris noctivagans (Le Conte)

Silver-haired Bat

Original description—"*Vespertilio noctivagans* Le Conte, McMurtrie's Cuvier's Animal Kingdom, **1**, June, 1831, p. 431."

Type locality—"Eastern United States."

Range—Chiefly Transition zone in northwestern California, south to Nicasio, Marin County, and Nevada City, Nevada County (Miller, N. Amer. Fauna, **13**, 1897, p. 86); east to Mount Shasta and to Oroville, Butte County (Mus. Vert. Zool.). Records for summer only.

Pipistrellus hesperus hesperus (H. Allen)

Canyon Bat

Original description—*Scotophilus hesperus* H. Allen, Smithsonian Misc. Coll., **7**, June, 1864, pp. 43, 44.

Type locality—Fort Yuma, Imperial County, California.

Synonyms—*Vesperugo hesperus,* part; Western Bat, part.

Range—Lower Sonoran zone east of the San Diegan district, on the Colorado and Mohave deserts, from the Mexican line north to the vicinity of Walker Pass and Owens Valley; west to Santa Rosa Mountains, Riverside County, and Fort Tejon, Kern County (Mus. Vert. Zool.).

Pipistrellus hesperus merriami (Dobson)

Merriam Bat

Original description—*Vesperugo merriami* Dobson, Ann. and Mag. Nat. Hist., 5th ser., **18**, 1886, p. 124.

Type locality—Red Bluff, Tehama County, California (*fide* Miller, N. Amer. Fauna, **13**, 1897, p. 31).

Synonyms—*Vesperugo hesperus,* part; *Pipistrellus hesperus,* part; Western Bat, part.

Range—Lower and Upper Sonoran zones west of the desert divides, from the Mexican line northwest through the San Diegan district, and through the San Joaquin and Sacramento valleys, east of the humid coast belt and west of the Sierra Nevada, to Butte and Tehama counties (Mus. Vert. Zool.).

Eptesicus fuscus fuscus (Beauvois)

Large Brown Bat

Original description—"*Vespertilio fuscus* Beauvois, Catal. Peale's Museum, Phila., 1796, p. 14."

Type locality—"Philadelphia, Pennsylvania."

Synonyms—*Eptesicus fuscus bernardinus* Rhoads, Proc. Acad. Nat. Sci. Phila., December, 1901, p. 619 (type from San Bernardino Valley, San Bernardino County, California); *Eptesicus fuscus melanopterus* Rehn, Proc. Acad. Nat. Sci. Phila., October 17, 1904, pp. 590, 591 (type from Mount Tallac, Eldorado County, California); *Adelonycteris fuscus;* San Bernardino Brown Bat; Black-winged Bat.

Range—Practically throughout the state, but chiefly Upper Sonoran and Transition zones. While there are very probably two or more subspecies, it is not possible at this writing to define them satisfactorily.

Nycteris borealis teliotis (H. Allen)

Western Red Bat

Original description—*Atalapha teliotis* H. Allen, Proc. Amer. Philos. Soc., 29, 1891, pp. 5, 6.

Type locality—Not known, but probably southern California.

Synonym—*Lasiurus borealis teliotis.*

Range—In winter and spring: Sacramento and San Joaquin valleys, from Sutter County southwards, and throughout the San Diegan district (Mus. Vert. Zool.). Evidently migratory.

Nycteris cinerea (Beauvois)

Hoary Bat

Original description—"*Vespertilio cinereus* Beauvois, Catal. Peale's Museum, Phila., 1796, p. 14."

Type locality—"Philadelphia, Pennsylvania."

Synonyms—Atalapha cinerea; Lasiurus cinereus.

Range—In winter and spring: valleys of west-central and southern California, south through the San Diegan district (Mus. Vert. Zool.); in summer, probably Transition and Boreal zones (see Stephens, Calif. Mammals, 1906, p. 272). Recorded without dates of capture north to Eureka, Humboldt County, and east to Panamint Mountains, Inyo County (Miller, N. Amer. Fauna, 13, 1897, p. 114).

Euderma maculatum (J. A. Allen)

Spotted Bat

Original description—Histiotus maculatus Allen, Bull. Amer. Mus. Nat. Hist., **3**, February 20, 1891, pp. 195-198.

Type locality—Mouth of Castac Creek, Santa Clara Valley, Los Angeles County, California (*fide* Merriam, N. Amer. Fauna, 13, 1897, p. 49).

Range—Arid Lower Sonoran zone; besides the type, secured as above, only one other specimen has been found within this state, at Mecca, Riverside County (Grinnell, Univ. Calif. Publ. Zool., **5**, 1910, pp. 317, 318, pl. 30).

Corynorhinus macrotis pallescens Miller

Pale Lump-nosed Bat

Original description—Corynorhinus macrotis pallescens Miller, N. Amer. Fauna, 13, October, 1897, p. 52.

Type locality—Keam Canyon, Navajo County, Arizona.

Synonym—Pallid Big-eared Bat.

Range—Lower and Upper Sonoran zones throughout southern California, north into Owens Valley (Miller, *supra cit.*), west through the San Diegan district to Santa Catalina Island (Mus. Vert. Zool.).

Corynorhinus macrotis townsendi (Cooper)

Northwestern Lump-nosed Bat

Original description—Plecotis townsendii Cooper, Ann. Lyc. Nat. Hist. N. Y., **4**, April, 1837, pp. 73, 74.

Type locality—Columbia River, Oregon.

Range—Upper Sonoran zone in west-central California: near Auburn, Placer County (Mus. Vert. Zool.).

August 26, 1913.

Antrozous pallidus pallidus (Le Conte)

Desert Pallid Bat

Original description—*Vespertilio pallidus* Le Conte, Proc. Acad. Nat. Sci. Phila., 7, December, 1855, p. 437.

Type locality—El Paso, El Paso County, Texas (*fide* Miller, Bull. 79, U. S. Nat. Mus., 1912, p. 68).

Synonym—Pale Bat; Big-eared Pale Bat.

Range—Lower Sonoran zone on the Colorado and Mohave deserts, north to Swansea, Inyo County, and west to Vallecito, eastern San Diego County (Mus. Vert. Zool.).

Antrozous pallidus pacificus Merriam

Pacific Pallid Bat

Original description—*Antrozous pallidus pacificus* Merriam, Proc. Biol. Soc. Wash., **11**, July 1, 1897, p. 180.

Type locality—Fort Tejon, Kern County, California.

Synonym—*Antrozous pallidus,* part.

Range—Lower and Upper Sonoran zones on the Pacific slope of California, from the Mexican line north through the San Diegan district and central coast district as far as Palo Alto and Oakland; also through the San Joaquin and Sacramento valleys to Fort Crook (near Burgettville), Shasta County (Mus. Vert. Zool.; Miller, N. Amer. Fauna, **13**, 1897, p. 45). Migratory.

Family MOLOSSIDAE

Nyctinomus femo osaccus Merriam

Pocketed Bat

Original description—*Nyctinomus femorosaccus* Merriam, N. Amer. Fauna, **2**, October, 1889, p. 23.

Type locality—Agua Caliente (=Palm Springs), Riverside County, California.

Synonyms—*Nyctinomops femorosaccus;* Palm Springs Free-tailed Bat.

Range—Lower Sonoran zone on the Colorado Desert at and near Palm Springs; only two specimens known (see Stephens, Calif. Mammals, 1906, p. 274; Elliot, Field Col. Mus., zool. ser., **3**, 1904, p. 321).

Nyctinomus depressus Ward

Tacubaya Free-tailed Bat

Original description—*Nyctinomus depressus* Ward, Amer. Nat., **25**, August, 1891, pp. 747-750.

Type locality—Tacubaya, Federal District, Mexico.

Synonyms—*Nyctinomus macrotis nevadensis* H. Allen, Bull. U. S. Nat. Mus., **43**, 1893 [=March, 1894], pp. 171-174, pls. 34, 35 (type from California, but exact locality not known: *fide* Lyon and Osgood, Bull. U. S. Nat. Mus., **62**, 1909, p. 280); Nevada Bat.

Range—Probably the southeastern deserts; but only the one indefinite record, as above.

Nyctinomus mexicanus Saussure

Mexican Free-tailed Bat

Original description—"*Nyctinomus mexicanus* Saussure, Rev. et Mag. de Zool., 2nd ser., **12**, 1860, p. 283."

Type locality—Ameca, Jalisco, Mexico (*fide* Miller, Bull. 79, U. S. Nat. Mus., 1912, p. 70).

Synonyms—*Nyctinomus mohavensis* Merriam, N. Amer. Fauna, **2**, October, 1889, p. 25 (type from Fort Mohave, Arizona); *Nyctinomus brasiliensis californicus* H. Allen, Bull. U. S. Nat. Mus., **43**, 1893 [=March, 1894], p. 166 (no type designated); *Nyctinomops mohavensis;* Mohave Bat.

Range—In spring and summer: Upper and Lower Sonoran zones, chiefly the latter, throughout southern California, both east and west of the desert divides, north at least to Marysville Buttes, Sutter County, and west to Palo Alto, Santa Clara County (Mus. Vert. Zool.). Doubtless migratory, at least in part.

Eumops californicus (Merriam)

California Mastiff Bat

Original description—*Molossus californicus* Merriam, N. Amer. Fauna, **4**, October 8, 1890, pp. 31, 32.

Type locality—Alhambra, Los Angeles County, California.

Synonyms—*Promops californicus; Promops perotis californicus;* Bonnet Bat.

Range—Lower Sonoran zone of southern California; most numerous in the San Diegan district, but noted also on the Colorado Desert, in the San Joaquin Valley, and in Kern and Fresno counties (Mus. Vert. Zool.); northernmost station, Fresno.

Order CARNIVORA

Family URSIDAE

Ursus horribilis californicus Merriam

California Grizzly

Original description—[*Ursus horribilis*] *californicus* Merriam, Proc. Biol. Soc. Wash., **10**, April 13, 1896, p. 76, fig. 15.

Type locality—Monterey, California.

Synonyms—*Ursus horribilis; Ursus horribilis horriaeus;* Grizzly Bear.

Range—Formerly almost throughout the state, except the southeastern deserts and the extreme northwestern humid coast belt. Zone, mostly Upper Sonoran and lower Transition. Now probably extinct.

Ursus americanus altifrontalis Elliot

Northwestern Black Bear

Original description—*Ursus altifrontalis* Elliot, Field Col. Mus., zool. ser., **3**, June, 1903, pp. 234, 235.

Type locality—Shore of Lake Crescent, Clallam County, Washington.

Synonyms—*Ursus americanus; Ursus cinnamoneus;* Cinnamon Bear; Brown Bear; Black Bear.

Range—Chiefly Transition and Boreal zones of northwestern California north of San Francisco Bay, and south along the Sierra Nevada at least as far as the Tehachapi Mountains, in Kern County. It is possible that the black bears of the Sierra Nevada belong to a separate and unnamed subspecies.

Family CANIDAE

Canis gigas (Townsend)

Northwestern Timber Wolf

Original description—*Lupus gigas* Townsend, Journ. Acad. Nat. Sci. Phila., n. s., **2**, November, 1850, pp. 75, 76.

Type locality—Fort Vancouver, Clarke County, Washington (see Miller, Smithsonian Misc. Colls., **59**, 1912, pp. 2, 4).

Synonyms—*Canis mexicanus; Canis nubilis; Canis lupus griseo-albus;* Gray Wolf.

Range—Northern California, and south along the Sierra Nevada. Now rare or extinct. The number of records (e. g., Price, Zoe, **4**, 1894, p. 331) and reports from the region specified carries conviction that a wolf of some form has occurred as above indicated. But lack of specimens brings doubt as to the race represented.

Canis latrans lestes Merriam

Mountain Coyote

Original description—*Canis lestes* Merriam, Proc. Biol. Soc. Wash., **11**, March 15, 1897, pp. 25, 26.

Type locality—Toyabe Mountains, near Cloverdale, Nye County, Nevada.

Range—Transition and Boreal zones of the Modoc region, west to Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 103) and south along the Sierra Nevada at least to Monache Meadows, Tulare County (Mus. Vert. Zool.).

Canis ochropus ochropus Eschscholtz

California Valley Coyote

Original description—*Canis ochropus* Eschscholtz, Zool. Atlas, **3**, 1829, pp. 1, 2, pl. 11.

Type locality—Tracy, San Joaquin County, California (fixed by Merriam, Proc. Biol. Soc. Wash., **11**, 1897, p. 32).

Synonyms—*Canis mearnsi;* Mearns Coyote; Valley Coyote.

Range—Throughout California west of the high Sierra Nevada, and south through the San Diegan district and included mountains to the Mexican line. Zone, chiefly Lower and Upper Sonoran, locally Transition. There is probably a slightly differentiated race in the San Diegan district (referred to *Canis mearnsi* by Stephens, Calif. Mammals, 1906, p. 216).

Canis ochropus estor Merriam

Desert Coyote

Original description—*Canis estor* Merriam, Proc. Biol. Soc. Wash., **11**, March 15, 1897, pp. 31, 32.

Type locality—Noland's Ranch, San Juan River, San Juan County, Utah.

Range—Lower Sonoran zone on the Colorado and Mohave deserts, west to Antelope Valley, northern Los Angeles County, and north through the Inyo region (Mus. Vert. Zool.).

Vulpes cascadensis Merriam

Cascade Red Fox

Original description—*Vulpes cascadensis* Merriam, Proc. Wash. Acad. Sci., 2, December 28, 1900, pp. 665, 666, pl. 36, fig. 3.

Type locality—Trout Lake, base of Mount Adams, Skamania County, Washington.

Synonyms—*Vulpes macrourus;* Mountain Red Fox.

Range—High Transition and Boreal zones on the northern Sierra Nevada, south as far as Mount Raymond, in Mariposa County (Merriam, *supra cit.*).

Vulpes necator Merriam

High Sierra Red Fox

Original description—*Vulpes necator* Merriam, Proc. Wash. Acad. Sci., 2, December 28, 1900, pp. 664, 665, pl. 36, fig. 2.

Type locality—Whitney Meadows, 9500 feet altitude, Sierra Nevada, Tulare County, California.

Range—Boreal zone of the southern Sierra Nevada, from Monache Meadows, Tulare County (Mus. Vert. Zool.), north at least to Atwell's Mill, East Fork Kaweah River, Tulare County (Merriam, *supra cit.*).

Vulpes macrotis macrotis Merriam

Long-eared Kit Fox

Original description—*Vulpes macrotis* Merriam, Proc. Biol. Soc. Wash., 4, 1888, pp. 135–138.

Type locality—Riverside, Riverside County, California.

Range—Lower Sonoran zone in the San Diegan district, northwest to Los Angeles County.

Vulpes macrotis muticus Merriam

San Joaquin Kit Fox

Original description—*Vulpes muticus* Merriam, Proc. Biol. Soc. Wash., **15**, March 22, 1902, p. 74.

Type locality—Tracy, San Joaquin County, California.

Range—Lower Sonoran zone in the San Joaquin Valley.

Vulpes macrotis arsipus Elliot

Mohave Desert Kit Fox

Original description—*Vulpes arsipus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 256.

Type locality—Daggett, Mohave Desert, San Bernardino County, California.

Range—Lower Sonoran zone on the Colorado and Mohave deserts, west to Palm Springs, Riverside County (Mus. Vert. Zool.), and north to the Panamint Mountains, Inyo County (Elliot, *supra cit.*).

Urocyon cinereoargenteus townsendi Merriam

Townsend Gray Fox

Original description—*Urocyon californicus townsendi* Merriam, N. Amer. Fauna, **16**, October, 1899, pp. 103, 104.

Type locality—Baird, Shasta County, California.

Range—Transition and Upper Sonoran zones in extreme northern California, from the interior of Humboldt County east to the vicinity of Mount Shasta (Mus. Vert. Zool.).

Urocyon cinereoargenteus sequoiensis Dixon

Redwood Gray Fox

Original description—*Urocyon californicus sequoiensis* Dixon, Univ. Calif. Publ. Zool., **5**, February 12, 1910, pp. 303–305.

Type locality—Lagunitas, Marin County, California.

Synonyms—*Urocyon californicus,* part; *Vulpes virginianus; Urocyon cinereoargenteus californicus,* part.

Range—High Upper Sonoran and Transition zones in the humid coast belt of west-central California, from Monterey Bay north to Lake County (Dixon, *supra cit.*).

Urocyon cinereoargenteus californicus Mearns

California Gray Fox

Original description—*Urocyon cinereoargenteus californicus* Mearns, Proc. U. S. Nat. Mus., **20**, January 12, 1897, pp. 459, 460.

Type locality—8000 feet altitude, in San Jacinto Mountains, Riverside County, California.

Synonyms—*Urocyon californicus; Urocyon virginianus littoralis.*

Range—Upper Sonoran and Transition zones in southern and central California west of the desert divides, and east and south of the humid coast belt.

Urocyon cinereoargenteus scotti Mearns

Arizona Gray Fox

Original description—*Urocyon virginianus scotti* Mearns, Bull. Amer. Mus. Nat. Hist., **3**, May, 1891, pp. 236–238.

Type locality—Pinal County, Arizona.

Synonyms—*Urocyon cinereo-argenteus inyoensis* Elliot, Field Col. Mus., zool. ser., **3**, March, 1904, pp. 268, 269 (type from Beveridge Canyon, Inyo Mountains, Inyo County, California) ; Inyo Mountains Gray Fox.

Range—Lower and Upper Sonoran zones on the Colorado and Mohave deserts and included mountains, from the Mexican line north to Inyo County, and west to the east line of the San Jacinto Mountains in Riverside County (Mus. Vert. Zool.).

Urocyon littoralis littoralis (Baird)

San Miguel Island Fox

Original description—*Vulpes (Urocyon) littoralis* Baird, Pac. R. R. Rep., **8**, 1857, pp. 143–145.

Type locality—San Miguel Island, Santa Barbara Islands, California.

Synonyms—Coast Fox; Short-tailed Fox.

Range—San Miguel Island.

Urocyon littoralis santacruzae Merriam

Santa Cruz Island Fox

Original description—*Urocyon littoralis santacruzae* Merriam, Proc. Biol. Soc. Wash., **16**, May 29, 1903, p. 75.

Type locality—Santa Cruz Island, Santa Barbara Islands, California.

Range—Santa Cruz Island.

Urocyon catalinae Merriam

Santa Catalina Island Fox

Original description—*Urocyon catalinae* Merriam, Proc. Biol. Soc. Wash., **16**, May 29, 1903, p. 74.

Type locality—Santa Catalina Island, Santa Barbara Islands, California.

Range—Santa Catalina Island.

Urocyon clementae Merriam

San Clemente Island Fox

Original description—*Urocyon clementae* Merriam, Proc. Biol. Soc. Wash., 16, May 29, 1903, p. 75.

Type locality—San Clemente Island, Santa Barbara Islands, California.

Range—San Clemente Island.

Family PROCYONIDAE

Bassariscus astutus raptor (Baird)

California Ring-tailed Cat

Original description—*Bassaris raptor* Baird, Mammals Mex. Boundary, 1859, p. 19.

Type locality—Northern California (see Merriam, Proc. Biol. Soc. Wash., 11, 1897, pp. 186, 187).

Synonyms—*Bassariscus flavus oregonus; Bassariscus astutus; Bassaris astuta;* Civet Cat; Raccoon-fox.

Range—Upper Sonoran and lower Transition zones west of the Sierran divides, from the San Diegan district north nearly to the Oregon line, though at the north chiefly east of the humid coast belt.

Procyon psora psora Gray

California Coon

Original description—*Procyon psora* Gray, Ann. and Mag. Nat. Hist., 10, 1842, p. 261.

Type locality—Sacramento, California.

Synonyms—*Procyon lotor; Procyon lotor hernandezi;* California Raccoon.

Range—Lower Sonoran, Upper Sonoran and lower Transition zones throughout California, except the northern border and the southeastern deserts.

Procyon psora pacifica Merriam

Pacific Coon

Original description—*Procyon psora pacifica* Merriam, N. Amer. Fauna, 16, October, 1899, p. 107.

Type locality—Keechelus Lake, Cascade Mountains, Kittitas County, Washington.

Range—Upper Sonoran and Transition zones along northern border of the state, south as far as Pitt River, Shasta County (Merriam, *supra cit.*).

Procyon pallidus Merriam

Pallid Coon

Original description—*Procyon pallidus* Merriam, Proc. Biol. Soc. Wash., 13, June 13, 1900, pp. 151, 152.

Type locality—New River, Colorado Desert, Imperial County, California.

Synonyms—Desert Raccoon; *Procyon lotor pallidus.*

Range—Lower Sonoran zone on the Colorado Desert, in Imperial County, and north along the Colorado River at least to Needles (Mus. Vert. Zool.).

Family MUSTELIDAE

Martes caurina caurina (Merriam)

Northwestern Pine Marten

Original description—*Mustela caurina* Merriam, N. Amer. Fauna, 4, October, 1890, pp. 27–29.

Type locality—Near Gray's Harbor, Chehalis County, Washington.

Synonym—*Mustela americanus.*

Range—Transition and Boreal zones in northwestern California, south to Mendocino County, east to Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 106), south over the central Sierra Nevada (Price, Zoe, **4**, 1894, p. 331).

Martes pennanti pacifica (Rhoads)

Pacific Fisher

Original description—*Mustela canadensis pacifica* Rhoads, Trans. Amer. Philos. Soc., n. s., **19**, September, 1898, pp. 435, 436.

Type locality—Lake Kichelos (=Keechelus), Kittitas County, Washington.

Synonyms—*Mustela pennanti; Mustela pennanti pacifica;* Pennant Marten.

Range—Transition and Boreal zones in northwestern California, south to Trinity County (Mus. Vert. Zool.), and along the Sierra Nevada, from Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 106) south at least to Eldorado County (Price, Zoe, **4**, 1894, p. 331).

Gulo luscus luteus Elliot

Sierra Nevada Wolverine

Original description—*Gulo luteus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 260.

Type locality—Crater Meadows (=Groundhog Meadow), Whitney Creek (=Golden Trout Creek), Sierra Nevada, Tulare County, California (see Elliot, *supra cit.*, p. 280).

Synonym—*Gulo luscus.*

Range—Boreal zone on the Sierra Nevada, from the vicinity of Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 105), south through the Lake Tahoe region (Belding, Zoe, **1**, December, 1890, p. 303; Price, Zoe, **4**, March, 1894, p. 331) to Monache Meadows, Tulare County (Mus. Vert. Zool.).

Mustela muricus (Bangs)

Sierra Least Weasel

Original description—*Putorius (Arctogale) muricus* Bangs, Proc. New Eng. Zool. Club, **1**, July 31, 1899, p. 71.

Type locality—Echo, Eldorado County, California.

Synonym—*Putorius muricus.*

Range—Known only from the type locality, as above.

Mustela arizonensis (Mearns)

Mountain Weasel

Original description—*Putorius arizonensis* Mearns, Bull. Amer. Mus. Nat. Hist., **3**, May, 1891, pp. 234, 235.

Type locality—San Francisco forest, near Flagstaff, Coconino County, Arizona.

Synonyms—Arizona Weasel; *Putorius brasiliensis frenatus.*

Range—Transition and Boreal zones along the Sierra Nevada, from Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 106) south to Tulare County, and the San Jacinto Mountains, Riverside County (Mus. Vert. Zool.).

Mustela xanthogenys xanthogenys Gray

California Weasel

Original description—*Mustela xanthogenys* Gray, Ann. and Mag. Nat. Hist., **11**, 1843, p. 118.

Type locality—Southern California, probably near San Diego (*fide* Merriam, N. Amer. Fauna, **11**, 1896, p. 25).

Synonyms—Yellow-cheeked Weasel; *Putorius xanthogenys.*

Range—Lower and Upper Sonoran zones west of the desert divides, from the Mexican line north through the San Diegan district, and west-central California east of the northern humid coast belt, at least to the head of the Sacramento Valley.

Mustela xanthogenys munda (Bangs)

Redwood Weasel

Original description—*Putorius xanthogenys mundus* Bangs, Proc. New Eng. Zool. Club, **1**, June 9, 1899, pp. 56, 57.

Type locality—Point Reyes, Marin County, California.

Range—Transition zone in the humid coast belt north of San Francisco Bay: Point Reyes and Nicasio, Marin County (Bangs, *supra cit.*), north to Humboldt Bay (Mus. Vert. Zool.). It is possible that the weasels of the region immediately south of San Francisco Bay also belong here.

Mustela vison energumenos (Bangs)

Pacific Mink

Original description—*Putorius vison energumenos* Bangs, Proc. Boston Soc. Nat. Hist., **27**, March, 1896, p. 5.

Type locality—Sumas, British Columbia, Canada.

Synonyms—*Putorius vison; Lutreola vison energumenos;* American Mink.

Range—Northern California along streams generally, south to Petaluma, Sonoma County, through the Sacramento and San Joaquin valleys at least to Stanislaus County, along the Sierra Nevada to Kern River in Tulare County, and through Owen's Valley at least to Fish Springs, near Big Pine, Inyo County (Mus. Vert. Zool.).

Spilogale gracilis gracilis Merriam

Canyon Spotted Skunk

Original description—*Spilogale gracilis* Merriam, N. Amer. Fauna, **3**, August, 1890, p. 83.

Type locality—Grand Canyon of the Colorado, Arizona, north of San Francisco Mountain.

Range—Sonoran zones of the Inyo region: Inyo and Panamint mountains, Inyo County (Howell, N. Amer. Fauna, **26**, 1906, p. 23).

Spilogale gracilis saxatilis Merriam

Great Basin Spotted Skunk

Original description—*Spilogale saxatilis* Merriam, N. Amer. Fauna, **4**, October, 1890, p. 13.

Type locality—Provo, Utah County, Utah.

Range—Extreme northeastern corner of the state in Upper Sonoran zone: Susanville, Lassen County (Howell, N. Amer. Fauna, **26**, 1906, p. 23).

Spilogale arizonae arizonae Mearns

Arizona Spotted Skunk

Original description—*Spilogale phenax arizonae* Mearns, Bull. Amer. Mus. Nat. Hist., **3**, June, 1891, pp. 256, 257.

Type locality—Fort Verde, Yavapai County, Arizona.

Range—Valley of lower Colorado River, near Pilot Knob, Imperial County: Lower Sonoran zone (Mus. Vert. Zool.).

Spilogale phenax phenax Merriam

California Spotted Skunk

Original description—*Spilogale phenax* Merriam, N. Amer. Fauna, **4**, October, 1890, pp. 13, 14.

Type locality—Nicasio, Marin County, California.

Synonyms—*Mephitis bicolor; Mephitis zorilla;* Hydrophobia Skunk; Western Spotted Skunk; Little Spotted Skunk, part.

Range—Lower and Upper Sonoran zones and, at the north, Transition, throughout southern and west-central California west of the desert divides, from the Mexican line north through the San Diegan district and along the western slopes of the Sierra Nevada and the central and northern coast strips to Shasta and Humboldt counties (Howell, N. Amer. Fauna, **26**, 1906, p. 32; Mus. Vert. Zool.).

Spilogale phenax latifrons Merriam

Oregon Spotted Skunk

Original description—*Spilogale phenax latifrons* Merriam, N. Amer. Fauna, **4**, October, 1890, p. 15.

Type locality—Roseburg, Douglas County, Oregon.

Synonym—Little Spotted Skunk, part.

Range—Extreme northwestern border of the state, in Siskiyou County: Siskiyou Mountains and Hornbrook (Howell, N. Amer. Fauna, **26**, 1906, p. 33).

Mephitis estor Merriam

Arizona Striped Skunk

Original description—*Mephitis estor* Merriam, N. Amer. Fauna, **3**, August, 1890, pp. 81, 82.

Type locality—San Francisco Mountain, Coconino County, Arizona.

Range—Extreme Lower Sonoran zone: Valley of the lower Colorado River, from Needles to the Mexican line (Mus. Vert. Zool.).

Mephitis occidentalis occidentalis Baird

Northern California Striped Skunk

Original description—*Mephitis occidentalis* Baird, Pac. R. R. Rep., **8**, 1857, p. 194.

Type locality—Petaluma, Sonoma County, California.

Synonyms—*Chincha occidentalis;* California Skunk.

Range—Upper Sonoran and Transition zones of the west-central and northern portions of the state, from about the latitude of Monterey Bay north to the Oregon line, east to Shasta Valley and the main Sierra Nevada (Howell, N. Amer. Fauna, **20**, 1901, pp. 34, 35; Mus. Vert. Zool.).

Mephitis occidentalis major (Howell)

Great Basin Striped Skunk

Original description—*Chincha occidentalis major* Howell, N. Amer. Fauna, **20**, August 31, 1901, pp. 37, 38.

Type locality—Fort Klamath, Klamath County, Oregon.

Range—Upper Sonoran and Transition zones in the Modoc region of northeastern California; west to Lassen Creek, Shasta County, south to Sierra Valley, Plumas County (Howell, *supra cit.;* Mus. Vert. Zool.).

Mephitis occidentalis holzneri Mearns

Southern California Striped Skunk

Original description—*Mephitis occidentalis holzneri* Mearns, Proc. U. S. Nat. Mus., **20**, January 12, 1897, p. 461.

Type locality—San Isidro Ranch, near United States boundary, Lower California, Mexico.

Synonyms—*Chincha occidentalis holzneri;* Lower California Skunk.

Range—Lower Sonoran, Upper Sonoran and Transition zones in southern California chiefly west of the deserts proper,

from the Mexican line north to about the latitude of Monterey; east to the southern Sierra Nevada and the western edges of the Mohave and Colorado deserts (Howell, N. Amer. Fauna, **20**, 1901, p. 38; Mus. Vert. Zool.).

Mephitis platyrhina (Howell)

Broad-nosed Striped Skunk

Original description—*Chincha platyrhina* Howell, N. Amer. Fauna, **20**, August 31, 1901, p. 39.

Type locality—South Fork of Kern River, 25 miles east of Kernville, Kern County, California.

Range—Lower Sonoran zone about southern end of Sierra Nevada; recorded only from valley of the South Fork of the Kern River, in Kern County, and from Owens Valley and Owens Lake, in Inyo County (Howell, *supra cit.*).

Taxidea taxus neglecta Mearns

California Badger

Original description—*Taxidea americana neglecta* Mearns, Bull. Amer. Mus. Nat. Hist., **3**, June, 1891, pp. 250, 251.

Type locality—Fort Crook (near Burgettville), Shasta County, California.

Synonyms—*Taxidea americana; Taxidea taxus*; Western Badger; American Badger.

Range—Chiefly Sonoran and Transition zones, casually Boreal, east and south of the humid coast belt, and northwest of the Colorado Desert; in other words, interior valleys, from the Oregon line east of the humid coast belt to the Mexican line west of the Colorado Desert; occurs both east and west of the Sierra Nevada (Mus. Vert. Zool.).

Taxidea taxus berlandieri Baird

Mexican Badger

Original description—*Taxidea berlandieri* Baird, Pac. R. R. Rep., **8**, 1857, p. 205.

Type locality—Llano Estacado, Texas, near border of New Mexico .

Range—Lower Sonoran zone on the Colorado Desert: Imperial Valley and north along the Colorado River at least to vicinity of Picacho (Mus. Vert. Zool.).

Lutra canadensis pacifica Rhoads

Pacific River Otter

Original description—*Lutra hudsonica pacifica* Rhoads, Trans. Amer. Philos. Soc., n. s., **19**, September, 1898, pp. 429–431.

Type locality—Lake Kichelos (=Keechelus), Kittitas County, Washington.

Synonyms—*Lutra californica; Lutra canadensis;* California Otter.

Range—Streams of northern California, south at least to Mendocino County, and through the Sacramento and San Joaquin valleys to the San Joaquin River, Fresno County.

Latax lutris nereis Merriam

Southern Sea Otter

Original description—*Latax lutris nereis* Merriam, Proc. Biol. Soc. Wash., **17**, October 6, 1904, p. 159.

Type locality—San Miguel Island, Santa Barbara Islands, California.

Synonyms—*Latax lutris; Enhydra lutris; Enhydra marina;* San Miguel Island Sea Otter.

Range—In the ocean along the exposed seashore and neighboring islands the whole length of the state, especially about the Santa Barbara and Farallon islands (see Scammon, Marine Mammals, 1874, pp. 168–174). Formerly abundant, now rare. It is possible that the animals which occurred off the northern California coast belonged to the northern subspecies.

Family FELIDAE

Felis oregonensis oregonensis Rafinesque

Northwestern Cougar

Original description—"*Felix* [=*Felis*] *oregonensis* Rafinesque, Atlantic Journal, **1**, 1832, p. 62."

Type locality—Northwestern coast of the United States (*fide* Stone, Science, n. ser., **9**, 1899, p. 35.)

Synonyms—*Felis concolor,* part; *Felis concolor oregonensis,* part; *Felis hippolestes olympus;* Pacific Coast Cougar; Northwestern Puma; Mountain Lion, part.

Range—Throughout the state except for the lower southeastern deserts. Ranges through all zones, though perhaps most plentiful in Upper Sonoran and Transition.

Felis oregonensis browni Merriam

Yuma Cougar

Original description—*Felis aztecus browni* Merriam, Proc. Biol. Soc. Wash., **16**, May 29, 1903, pp. 73, 74.

Type locality—Lower Colorado River, 12 miles south of Yuma, Arizona.

Synonyms—*Felis concolor,* part; *Felis concolor oregonensis,* part; Mountain Lion, part; Brown Cougar.

Range—Lower Sonoran zone on the Colorado Desert, and north along the Colorado River (Mus. Vert. Zool.).

Lynx fasciatus oculeus Bangs

Southern Barred Wildcat

Original description—*Lynx (Cervaria) fasciatus oculeus* Bangs, Proc. New Eng. Zool. Club, **1**, March 31, 1899, pp. 23, 24.

Type locality—Nicasio, Marin County, California.

Synonyms—*Felis rufa oculea;* Sharp-sighted Lynx.

Range—Upper Sonoran and Transition zones of the northwestern coast belt, from Marin County north probably to the Oregon line (Bangs, *supra cit.*).

Lynx fasciatus pallescens Merriam

Pallid Barred Wildcat

Original description—*Lynx fasciatus pallescens* Merriam, N. Amer. Fauna, **16**, October, 1899, p. 104.

Type locality—South base of Mount Adams, near Trout Lake, Skamania County, Washington.

Synonyms—*Felis rufa pallescens;* Pallid Lynx.

Range—Interior of northern California; vicinity of Mount Shasta south to Pitt River, in Shasta County (Merriam, *supra cit.*).

Lynx eremicus eremicus Mearns

Desert Wildcat

Original description—*Lynx rufus eremicus* Mearns, Proc. U. S. Nat. Mus., **20**, January 12, 1897, pp. 457, 458.

Type locality—New River, 6 miles northwest of Laguna Station, Colorado Desert, Imperial County, California.

Synonyms—Desert Lynx, part; *Felis rufa eremica.*

Range—Lower Sonoran zone on the Colorado and Mohave deserts, north at least to Needles, west to Victorville, San Bernardino County (Mus. Vert. Zool.).

Lynx eremicus californicus Mearns

California Wildcat

Original description—*Lynx rufus californicus* Mearns, Proc. U. S. Nat. Mus., **20**, January 12, 1897, p. 458.

Type locality—San Diego, California.

Synonyms—*Lynx californicus; Lynx eremicus,* part; Desert Lynx, part; *Felis rufa californica.*

Range—Sonoran, Transition, and lower Boreal zones throughout the greater portion of the state west and north of the desert proper, and south and east of the northern coast belt (Mus. Vert. Zool.). Northernmost record along the Sierra Nevada: Baird, Shasta County (Merriam, N. Amer. Fauna, **16**, 1899, p. 104).

Order PINNIPEDIA

Family OTARIIDAE

Zalophus californianus (Lesson)

California Sea Lion

Original description—"*Otaria californiana* Lesson, Dict. Class. Hist. Nat., **13**, 1828, p. 420."

Type locality—"California."

Synonyms—"*Otaria gillespii* M'Bain, Proc. Edinb. Roy. Soc., 1, 1858, p. 422 (type from California)"; *Zalophus gillespii; Arctocephalus gilliespii;* Lobo Marino.

Range—Seacoast and islands of southern California, breeding northwards from near the Mexican line to San Miguel Island; occurs at times farther north even to San Francisco Bay (J. Rowley, MS; Mus. Vert. Zool.).

Eumetopias stelleri (Lesson)

Steller Sea Lion

Original description—"*Otaria stelleri* Lesson, Dict. Class Hist. Nat., 13, 1828, p. 420."

Type locality—"North Pacific Ocean."

Synonyms—*Eumetopias jubata; Otaria jubata; Arctocephalus monteriensis* Gray, Proc. Zool. Soc. London, 1859, pp. 358, 360, pl. 72 (type from Monterey).

Range—Seacoast and islands of central and northern California, breeding northwards from Richardson Rock, near San Miguel Island, to near the Oregon line (J. Rowley, MS; Mus. Vert. Zool.).

Callotaria alascana (Jordan and Clark)

Pribilof Fur Seal

Original description—*Callorhinus alascanus* Jordan and Clark, Fur Seals and Fur Seal Islands of North Pacific Ocean, pt. 3, 1899, p. 2.

Type locality—Pribilof Islands, Bering Sea.

Synonyms—*Callorhinus ursinus,* part; Northern Fur Seal, part.

Range—In the annual migrations this fur seal occurs from January to March on the ocean off northern California, south as far as the vicinity of Point Conception (see Townsend, *in* Fur Seals and Fur Seal Islands of North Pacific Ocean, pt. 3, 1899, pp. 223–252, map).

Arctocephalus townsendi Merriam

Guadalupe Fur Seal

Original description—*Arctocephalus townsendi* Merriam, Proc. Biol. Soc. Wash., 11, July 1, 1897, p. 178.

Type locality—Guadalupe Island, off Lower California, Mexico.

Synonyms—*Callorhinus ursinus,* part; Northern Fur Seal, part.

Range—With little doubt fur seals formerly bred along the coast and among the islands of southern California (Scammon, Marine Mammals, 1874, p. 154; Stephens, Calif. Mammals, 1906, p. 206). The geographical probabilities strongly favor their identity with the southern form possibly still in existence off Lower California, rather than with the fur seal breeding on the Pribilof Islands, in Bering Sea.

Family PHOCIDAE

Phoca richardi geronimensis Allen

California Harbor Seal

Original description—*Phoca richardi geronimensis* Allen, Bull. Amer. Mus. Nat. Hist., **16**, December 12, 1902, pp. 493, 495, 496.

Type locality—San Geronimo Island, Lower California.

Synonyms—*Phoca pealei; Phoca richardi; Phoca vitulina;* San Geronimo Harbor Seal.

Range—Seacoast, islands, and bays, from the Mexican to the Oregon lines. It is probable that the harbor seals of the northern coast district will be found to be in characters nearest *Phoca richardi richardi.*

Macrorhinus angustirostris Gill

Northern Elephant Seal

Original description—"*Macrorhinus angustirostris* Gill, Proc. Chicago Acad. Sci., **1**, 1866, p. 33."

Type locality—"Saint Bartholomew's Bay, Lower California, Mexico."

Synonyms—*Mirounga angustirostris;* Sea Elephant.

Range—Formerly north along the seacoast as far as Point Reyes, Marin County (Scammon, Proc. Acad. Nat. Sci. Phila., 1869, p. 61); occurred in numbers at Santa Barbara Island as late as 1852 (Scammon, Marine Mammals, 1874, p. 118);

now restricted to the vicinity of Guadalupe Island, Lower California (Townsend, Zoologica, N. Y. Zool. Soc., 1, 1912, p. 171).

Order RODENTIA

Family MURIDAE

Onychomys leucogaster brevicaudus Merriam

Short-tailed Grasshopper Mouse

Original description—*Onychomys leucogaster brevicaudus* Merriam, N. Amer. Fauna, 5, July, 1891, p. 52.

Type locality—Blackfoot, Bingham County, Idaho.

Range—High Upper Sonoran zone along the extreme eastern edge of the state, in the Modoc region: Sugar Hill and Dry Creek, Warner Mountains, south to Benton, Mono County (Mus. Vert. Zool.).

Onychomys torridus torridus (Coues)

Arizona Grasshopper Mouse

Original description—*Hesperomys (Onychomys) torridus* Coues, Proc. Acad. Nat. Sci. Phila., December 15, 1874, p. 183.

Type locality—Camp Grant, Graham County, Arizona.

Synonyms—*Onychomys pulcher* Elliot, Field Col. Mus., zool. ser., 3, December, 1903, pp. 243, 244 (type from Morongo Pass, east end of San Bernardino Mountains, California); *Onychomys torridus perpallidus; Onychomys torridus longicaudus.*

Range—Lower Sonoran zone on Colorado and Mohave deserts; west to Jacumba, San Diego County, Whitewater, Riverside County, and Antelope Valley, northern Los Angeles County, north to Independence, Inyo County (Mus. Vert. Zool.).

Onychomys torridus ramona Rhoads

Ramona Grasshopper Mouse

Original description—*Onychomys ramona* Rhoads, Amer. Nat., 27, September, 1893, pp. 833, 834.

Type locality—San Bernardino Valley, San Bernardino County, California.

Synonym—San Bernardino Grasshopper Mouse.

Range—Lower Sonoran zone on the Pacific slope of the San Diegan district from the Mexican line northwest at least to San Fernando Valley, Los Angeles County (Mus. Vert. Zool.).

Onychomys torridus tularensis Merriam

Tulare Grasshopper Mouse

Original description—*Onychomys torridus tularensis* Merriam, Proc. Biol. Soc. Wash., 17, June 9, 1904, p. 123.

Type locality—Bakersfield, Kern County, California.

Range—Lower Sonoran zone in the southern San Joaquin Valley; east to Kern Valley; west to Carrizo Plains, San Luis Obispo County; north to Huron, Fresno County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Reithrodontomys megalotis longicauda (Baird)

Long-tailed Harvest Mouse

Original description—*Reithrodon longicauda* Baird, Pac. R. R. Rep., 8, 1857, pp. 451, 452.

Type locality—Petaluma, Sonoma County, California.

Synonyms—*Reithrodontomys pallidus* Rhoads, Amer. Nat., 27, September, 1893, p. 835 (type from Santa Ysabel [=Witch Creek], San Diego County, California); *Ochetodon longicauda, Reithrodontomys longicauda; Reithrodontomys longicauda pallidus;* Sonoma Harvest Mouse.

Range—Upper Sonoran and lower Transition zones of the greater portion of California west of the Sierran divides, from the Mexican boundary north through the San Diegan district, and through both the coast belt and San Joaquin and Sacramento valleys, to Trinidad, Humboldt County, and Scott River Valley, Siskiyou County (Mus. Vert. Zool.).

Reithrodontomys megalotis klamathensis Merriam

Klamath Harvest Mouse

Original description—*Reithrodontomys klamathensis* Merriam, N. Amer. Fauna, 16, October, 1899, p. 93.

Type locality—Big Spring (= Mayten), Shasta Valley, Siskiyou County, California.

Range—Upper Sonoran zone of the Modoc region, west to Montague, Siskiyou County, and south to Vinton, Plumas County (Mus. Vert. Zool.).

Reithrodontomys megalotis deserti Allen

Desert Harvest Mouse

Original description—Reithrodontomys megalotis deserti Allen, Bull. Amer. Mus. Nat. Hist., 7, May 21, 1895, pp. 127–129.

Type locality—Oasis Valley, Nye County, Nevada.

Synonym—Reithrodontomys megalotis.

Range—Lower and Upper Sonoran zones of the Colorado and Mohave desert areas, west to the eastern border of the San Diegan district, and north, east of the Sierra Nevada, to the head of Owens Valley (Mus. Vert. Zool.).

Reithrodontomys megalotis catalinae Elliot

Catalina Island Harvest Mouse

Original description—Reithrodontomys catalinae Elliot, Field Col. Mus., zool. ser., 3, December, 1903, p. 246.

Type locality—Santa Catalina Island, Santa Barbara group, California.

Range—Santa Catalina Island, Santa Barbara group (Elliot, *supra cit.;* Mus. Vert. Zool.).

Reithrodontomys halicoetes Dixon

Tidal Marsh Harvest Mouse

Original description—Reithrodontomys halicoetes Dixon, Univ. Calif. Publ. Zool., 5, August 14, 1909, pp. 271–273.

Type locality—Salt marsh 3 miles south of Petaluma, Sonoma County, California.

Synonym—Salt Marsh Harvest Mouse, part.

Range—Tidal marshes on the north side of San Francisco and Suisun bays, from Petaluma east to Grizzly Island (Mus. Vert. Zool.).

Reithrodontomys raviventris Dixon

Red-bellied Harvest Mouse

Original description—Reithrodontomys raviventris Dixon, Proc. Biol. Soc. Wash., 21, October 20, 1908, pp. 197, 198.

Type locality—Redwood City, San Mateo County, California.

Synonym—Salt Marsh Harvest Mouse, part.

Range—Salt marshes bordering the south arm of San Francisco Bay, from Redwood City around to Melrose Marsh, Alameda County (Dixon, *supra cit.;* Mus. Vert. Zool.).

Peromyscus maniculatus rubidus Osgood

Redwood White-footed Mouse

Original description—*Peromyscus oreas rubidus* Osgood, Proc. Biol. Soc. Wash., **14**, December 12, 1901, p. 193.

Type locality—Mendocino City, Mendocino County, California.

Synonyms—*Peromyscus gambeli,* part; *Peromyscus texensis gambeli.*

Range—Humid northwest coast belt, in Upper Sonoran, Transition, and Boreal zones, from the Oregon line (east to Siskiyou Mountains) south to Golden Gate; also locally in the redwood belt south of San Francisco Bay as far as Sur, Monterey County (Osgood, N. Amer. Fauna, **28**, 1909, p. 66; Mus. Vert. Zool.).

Peromyscus maniculatus gambeli (Baird)

Gambel White-footed Mouse

Original description—*Hesperomys gambelii* Baird, Pac. R. R. Rep., **8**, 1857, p. 464.

Type locality—Monterey, California (see Allen, Bull. Amer. Mus. Nat. Hist., **5**, 1893, p. 190).

Synonyms—*Peromyscus gambeli,* part; *Mus leucopus; Peromyscus sonoriensis gambeli; Peromyscus texanus gambeli; Sitomys americanus gambeli; Peromyscus texanus medius.*

Range—Throughout all zones and over the greater portion of the state, from the Oregon line east of the humid coast belt, to the Mexican line west of the Colorado desert (Osgood, N. Amer. Fauna, **28**, 1909, p. 67; Mus. Vert. Zool.); in other words, California *except* humid coast belt north of San Francisco Bay, and southeastern desert regions. The most abundant and at the same time wide-spread single mammal of the state.

Peromyscus maniculatus sonoriensis (Le Conte)

Sonora White-footed Mouse

Original description—*Hesperomys sonoriensis* Le Conte, Proc. Acad. Nat. Sci. Phila., **6**, October, 1853, p. 413.

Type locality—Santa Cruz, Sonora, Mexico.

Synonyms—*Hesperomys leucopus deserticolus* Mearns, Bull. Amer. Mus. Nat. Hist., **2**, February, 1890, pp. 285–287 (type from Mohave River, 12 miles below Hesperia, San Bernardino County, California); *Sitomys insolatus* Rhoads, Proc. Acad. Nat. Sci. Phila., October, 1894, p. 256 (type from Oro Grande, San Bernardino County, California); Desert Deer Mouse; *Peromyscus texensis thurberi.*

Range—Colorado and Mohave deserts and adjacent mountain ranges, west to Mount Pinos, Ventura County, and north through the Inyo region to Alpine County (Osgood, N. Amer. Fauna, **28**, 1909, pp. 92, 93; Mus. Vert. Zool.).

Peromyscus maniculatus clementis Mearns

San Clemente White-footed Mouse

Original description—*Peromyscus texanus clementis* Mearns, Proc. U. S. Nat. Mus., **18**, March 25, 1896, pp. 446, 447.

Type locality—San Clemente Island, California.

Range—Outer islands of Santa Barbara group, including San Clemente, Santa Barbara, San Nicolas, Santa Rosa, and San Miguel islands (Osgood, N. Amer. Fauna, **28**, 1909, p. 96).

Peromyscus maniculatus catalinae Elliot

Catalina Island White-footed Mouse

Original description—*Peromyscus catalinae* Elliot, Field Col. Mus., zool. ser., **3**, April, 1903, p. 160.

Type locality—Santa Catalina Island, California.

Range—Santa Catalina and Santa Cruz islands, Santa Barbara group (Osgood, N. Amer. Fauna, **28**, 1909, p. 97; Mus. Vert. Zool.).

Peromyscus boylei boylei (Baird)

Boyle White-footed Mouse

Original description—*Hesperomys boylii* Baird, Proc. Acad. Nat. Sci. Phila., **7**, April, 1855, pp. 335–336.

Type locality—Middle Fork American River, Eldorado County, California, near Auburn (*fide* Osgood, N. Amer. Fauna, **28**, 1909, p. 142).

Synonym—*Sitomys robustus* Allen, Bull. Amer. Mus. Nat. Hist., **5**, December 16, 1893, p. 335 (type from Lakeport, Lake County, California).

Range—Upper Sonoran and Transition zones along Sierra Nevada, from vicinity of Yosemite north to Mount Shasta, thence west to Trinity Mountains and south along inner coast ranges nearly to San Francisco Bay (Osgood, N. Amer. Fauna, **28**, 1909, p. 142; Mus. Vert. Zool.).

Peromyscus boylei rowleyi (Allen)

Rowley White-footed Mouse

Original description—*Sitomys rowleyi* Allen, Bull. Amer. Mus. Nat. Hist., **5**, April 28, 1893, p. 76.

Type locality—Noland Ranch, San Juan River, Utah (*fide* Osgood, N. Amer. Fauna, **28**, 1909, p. 145).

Synonyms—*Sitomys major* Rhoads, Amer. Nat., **27**, September, 1893, pp. 831, 832 (type from Squirrel Inn, San Bernardino Mountains, San Bernardino County, California); *Peromyscus parasiticus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 244 (type from Lone Pine, Inyo County, California); *Hesperomys aztecus.*

Range—Upper Sonoran and Transition zones along mountains of southern California, north through coast ranges to Monterey County and in southern Sierra Nevada through Tulare County, thence east across Owens Valley and on Providence Mountains (Osgood, N. Amer. Fauna, **28**, 1909, pp. 146, 147; Mus. Vert. Zool.).

Peromyscus truei truei (Shufeldt)

True White-footed Mouse

Original description—*Hesperomys truei* Shufeldt, Proc. U. S. Nat. Mus., **8**, 1885, pp. 407, 408.

Type locality—Fort Wingate, McKinley County, New Mexico.

Synonyms—*Peromyscus lasius* Elliot, Field Col. Mus., zool. ser., **3**, March, 1904, p. 265 (type from Hannopee Canyon,

Panamint Mountains, Inyo County, California); *Peromyscus montipinoris* Elliot, *ibid.*, p. 264 (type from Lockwood Valley, Mount Pinos, Ventura County, California).

Range—Upper Sonoran and Transition zones along eastern border of the state, chiefly east of the Sierra Nevada in the Inyo region; thence west through the extreme southern Sierra Nevada to the vicinity of Mount Pinos, Ventura County; north to Susanville, Lassen County; south to Providence Mountains, San Bernardino County (Osgood, N. Amer. Fauna, **28**, 1909, p. 169; Mus. Vert. Zool.).

Peromyscus truei gilberti (Allen)

Gilbert White-footed Mouse

Original description—*Sitomys gilberti* Allen, Bull. Amer. Mus. Nat. Hist., **5**, August, 1893, p. 188.

Type locality—Bear Valley, San Benito County, California.

Synonyms—*Peromyscus dyselius* Elliot, Field Col. Mus., zool. ser., 1, March, 1898, pp. 207, 208 (type from Portola, San Mateo County, California); *Peromyscus boylei,* part.

Range—Upper Sonoran zone along central and northern Sierra Nevada, and in coast ranges of middle California and of northern California east of the humid coast belt; south to Santa Barbara County; north to the Oregon line (Osgood, N. Amer. Fauna, **28**, 1909, p. 171; Mus. Vert. Zool.).

Peromyscus truei martirensis (Allen)

San Pedro Martir White-footed Mouse

Original description—*Sitomys martirensis* Allen, Bull. Amer. Mus. Nat. Hist., **5**, August 18, 1893, p. 187.

Type locality—San Pedro Martir Mountains, altitude 7000 feet, Lower California, Mexico.

Synonym—San Pedro Martir Big-eared Mouse.

Range—Upper Sonoran zone along mountains of extreme southern California, north through the San Jacinto and San Bernardino ranges (Osgood, N. Amer. Fauna, **28**, 1909, p. 172; Mus. Vert. Zool.).

Peromyscus crinitus crinitus (Merriam)

Idaho Canyon Mouse

Original description—*Hesperomys crinitus* Merriam, N. Amer. Fauna, **5**, July, 1891, pp. 53, 54.

Type locality—Shoshone Falls, Snake River, Idaho.

Range—Upper Sonoran zone on extreme northeastern border of the state: eastern Lassen and Modoc counties (Osgood, N. Amer. Fauna, **28**, 1909, p. 231; Mus. Vert. Zool.).

Peromyscus crinitus stephensi Mearns

Stephens Canyon Mouse

Original description—*Peromyscus stephensi* Mearns, Proc. U. S. Nat. Mus., **19**, July 30, 1897, p. 721.

Type locality—Lowest water on wagon road in canyon at eastern base of the Coast Range, near Mexican boundary, San Diego County, California.

Synonym—*Peromyscus petraius* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 244 (type from Lone Pine, Inyo County, California).

Range—Lower Sonoran zone on parts of Colorado and Mohave deserts, north through Inyo region to White Mountains and head of Owens Valley; west to Onyx, Kern County, and to east slopes of San Bernardino and San Jacinto mountains; southeast to Pilot Knob near Colorado River (Osgood, N. Amer. Fauna, **28**, 1909, pp. 233, 234; Mus. Vert. Zool.).

Peromyscus californicus californicus (Gambel)

Parasitic White-footed Mouse

Original description—*Mus californicus* Gambel, Proc. Acad. Nat. Sci. Phila., **4**, August, 1848, p. 78.

Type locality—Monterey, California.

Range—Upper Sonoran and Transition zones of coast region south from San Francisco Bay to Ventura County; thence east sparingly to western foothills of Sierra Nevada in Kern and Tulare counties (Osgood, N. Amer. Fauna, **28**, 1909, p. 237; Mus. Vert. Zool.).

Peromyscus californicus insignis Rhoads

Southern Parasitic Mouse

Original description—*Peromyscus insignis* Rhoads, Proc. Acad. Nat. Sci. Phila., March, 1895, p. 33.

Type locality—Dulzura, San Diego County, California.

Synonym—*Hesperomys californicus.*

Range—Upper Sonoran zone in southern California from San Gabriel Mountains in Los Angeles County south to the Mexican line (Osgood, N. Amer. Fauna, **28**, 1909, p. 238; Mus. Vert. Zool.).

Peromyscus eremicus eremicus (Baird)

Desert White-footed Mouse

Original description—*Hesperomys eremicus* Baird, Pac. R. R. Rep., **8**, 1857, pp. 479, 480.

Type locality—Fort Yuma, Imperial County, California.

Range—Lower Sonoran zone on Colorado desert and eastern parts of Mohave desert, west to east base of San Jacinto Mountains, and north to the Death Valley region (Osgood, N. Amer. Fauna, **28**, 1909, p. 242; Mus. Vert. Zool.).

Peromyscus eremicus fraterculus (Miller)

Dulzura White-footed Mouse

Original description—*Vesperimus fraterculus* Miller, Amer. Nat., **26**, March, 1892, pp. 261–263.

Type locality—Dulzura, San Diego County, California.

Synonyms—*Sitomys herroni* Rhoads, Amer. Nat., **27**, September, 1893, pp. 832, 833 (type from San Bernardino Valley [= Reche Canyon], San Bernardino County, California); *Sitomys herroni nigellus* Rhoads, Proc. Acad. Nat. Sci. Phila., October, 1894, p. 257 (type from west Cajon Pass, San Bernardino County, California).

Range—San Diegan district west of the desert divide, from Nordhoff, Ventura County, southeast to the Mexican line, chiefly in Lower Sonoran zone (Osgood, N. Amer. Fauna, **28**, 1909, p. 244; Mus. Vert. Zool.).

Sigmodon hispidus eremicus Mearns

Western Desert Cotton Rat

Original description—*Sigmodon hispidus eremicus* Mearns, Proc. U. S. Nat. Mus., **20**, March 5, 1897, pp. 504, 505.

Type locality—Cienaga Well, 30 miles south of Mexican boundary, on left bank of Colorado River, Sonora, Mexico.

Range—Valley of the lower Colorado River, from near Palo Verde to near Pilot Knob (Mus. Vert. Zool.).

Neotoma albigula venusta True

Colorado Valley Wood Rat

Original description—*Neotoma venusta* True, Proc. U. S. Nat. Mus., **17**, June 27, 1894, p. 354.

Type locality—Carrizo Creek, western Imperial County, California.

Synonyms—*Neotoma cumulator* Mearns, Proc. U. S. Nat. Mus., **20**, March 5, 1897, p. 503 (type from Fort Yuma, Imperial County, California); *Neotoma desertorum grandis* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 247 (type from Cameron Lake, near Tehachapi, Kern County, California).

Range—Lower Sonoran zone in bed of the Colorado desert, from the Mexican line northwest at least to Mecca, Riverside County, west to extreme eastern San Diego County, and north along the Colorado River, at least to near Riverside Mountain; also sporadically (?) to Cameron Lake, near Tehachapi, Kern County (Goldman, N. Amer. Fauna, **31**, 1910, p. 34; Mus. Vert. Zool.).

Neotoma intermedia intermedia Rhoads

Intermediate Wood Rat

Original description—*Neotoma intermedia* Rhoads, Amer. Nat., **28**, January, 1894, pp. 69, 70.

Type locality—Dulzura, San Diego County, California.

Synonyms—*Neotoma californica* Price, Proc. Calif. Acad. Sci., 2nd ser., **4**, May 9, 1894, pp. 154–156 (type from Bear Valley, San Benito County, California); Rhoads Wood Rat; Dulzura White-footed Wood Rat.

Range—Upper and Lower Sonoran zones west of the desert divides, from the Mexican line in the San Diegan district north through the coast region into Monterey and San Benito counties; also in western foothills of extreme southern Sierra Nevada north as far as Porterville, Tulare County (Goldman, N. Amer. Fauna, 31, 1910, p. 44; Mus. Vert. Zool.).

Neotoma intermedia gilva Rhoads

Banning Wood Rat

Original description—*Neotoma intermedia gilva* Rhoads, Amer. Nat., 28, January, 1894, p. 70.

Type locality—Banning, Riverside County, California.

Synonym—*Neotoma desertorum sola* Merriam, Proc. Biol. Soc. Wash., 9, July 2, 1894, p. 126 (type from San Emigdio, Kern County, California); Yellow Wood Rat.

Range—Arid Upper and Lower Sonoran zones along the eastern edge of the main range of *N. i. intermedia,* from Stanley, Fresno County, southeast to the Mexican line, and east through the Tehachapi region to the valley of the South Fork of the Kern River; the range of *gilva* thus lies irregularly between that of *intermedia* and that of *N. i. desertorum* (Mus. Vert. Zool.; Goldman, N. Amer. Fauna, 31, 1910, pp. 45, 46).

Neotoma intermedia desertorum Merriam

Desert Wood Rat

Original description—*Neotoma desertorum* Merriam, Proc. Biol. Soc. Wash., 9, July 2, 1894, pp. 125, 126.

Type locality—Furnace Creek, Death Valley, Inyo County, California.

Synonym—*Neotoma bella* Bangs, Proc. New Eng. Zool. Club, 1, July 31, 1899, pp. 66, 67 (type from Palm Springs, Riverside County, California).

Range—Lower and Upper Sonoran zones on the southeastern deserts, from the Mexican line north through the Inyo region to the head of Owens Valley in Mono County, and in extreme eastern Lassen County; west southerly to the east base of the San Jacinto Mountains, in Riverside County, and to Antelope Valley, in northern Los Angeles County (Goldman, N. Amer. Fauna, 31, 1910, p. 78; Mus. Vert. Zool.).

Neotoma fuscipes fuscipes Baird

Dusky-footed Wood Rat

Original description—*Neotoma fuscipes* (Cooper, MS) Baird, Pac. R. R. Rep., **8**, 1857, pp. 495, 496.

Type locality—Petaluma, Sonoma County, California.

Synonyms—*Neotoma splendens* True, Proc. U. S. Nat. Mus., 17, June 27, 1894, p. 353 (type from Marin County, California); *Neotoma fuscipes streatori*, part.

Range—Upper Sonoran and Transition zones north of San Francisco Bay, both coastwise and interiorly west of the Sacramento Valley, to the Oregon line; eastwards at the north through Siskiyou and Shasta counties as far as Haydenhill, Lassen County (Goldman, N. Amer. Fauna, **31**, 1910, pp. 87–89; Mus. Vert. Zool.).

Neotoma fuscipes streatori Merriam

Streator Wood Rat

Original description—*Neotoma fuscipes streatori* Merriam, Proc. Biol. Soc. Wash., **9**, July 2, 1894, p. 124.

Type locality—Carbondale, Amador County, California.

Range—Upper Sonoran and lower Transition zones along west slope of Sierra Nevada, from Tehama County south to near Porterville, Tulare County (Goldman, N. Amer. Fauna, **31**, 1910, pp. 89, 90; Mus. Vert. Zool.).

Neotoma fuscipes annectens Elliot

Portola Wood Rat

Original description—*Neotoma fuscipes annectens* Elliot, Field Col. Mus., zool. ser., **1**, March, 1898, pp. 201, 202.

Type locality—Portola, San Mateo County, California.

Synonyms—*Neotoma fuscipes affinis* Elliot, *ibid.*, pp. 202, 203 (type from Alum Rock Park, Santa Clara County, California); *Neotoma fuscipes*, part.

Range—Upper Sonoran and Transition zones in the coast region south from San Francisco Bay to Monterey Bay; thence interiorly and south along the inner coast ranges as far as the Carrizo Plain, San Luis Obispo County; east at the north to include the Mount Diablo and Mount Hamilton ranges (Goldman, N. Amer. Fauna, **31**, 1910, pp. 90, 91; Mus. Vert. Zool.).

August 26, 1913.

Neotoma fuscipes simplex True

Fort Tejon Wood Rat

Original description—Neotoma macrotis simplex True, Proc. U. S. Nat. Mus., **17**, June 27, 1894, p. 354.

Type locality—Fort Tejon, Kern County, California.

Synonym—Neotoma fuscipes dispar Merriam, Proc. Biol. Soc. Wash., **9**, July 2, 1894, pp. 124, 125 (type from Lone Pine, Inyo County, California).

Range—Upper Sonoran zone on the east and southeast slopes of the southern Sierra Nevada, in Inyo and Kern counties, thence west through the Tehachapi region to the vicinity of Tejon Pass and adjacent foothills to the north and south (Goldman, N. Amer. Fauna, **31**, 1910, pp. 91, 92; Mus. Vert. Zool.).

Neotoma fuscipes mohavensis Elliot

Mohave Wood Rat

Original description—Neotoma fuscipes mohavensis Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 246.

Type locality—Oro Grande, on Mohave River, San Bernardino County, California.

Synonym—Neotoma fuscipes macrotis, part.

Range—Upper and Lower Sonoran zones on the San Jacinto and San Bernardino mountains, including the adjacent foothills on the desert side; also from the latter mountains down along the Mohave River into the Mohave desert at least as far as Oro Grande (Elliot, *supra cit.;* Mus. Vert. Zool.).

Neotoma fuscipes macrotis Thomas

Long-eared Wood Rat

Original description—Neotoma macrotis Thomas, Ann. and Mag. Nat. Hist., 6th ser., **12**, September, 1893, pp. 234, 235.

Type locality—San Diego, San Diego County, California.

Synonym—Neotoma fuscipes cnemophila Elliot, Field Col. Mus., zool. ser., **3**, March, 1904, pp. 267, 268 (type from Lockwood Valley, near Mt. Pinos, Ventura County, California).

Range—Upper Sonoran and lower Transition zones in the San Diegan district, northwest from the Mexican line, including also the narrow coast strip still farther northwards even to

Monterey (Goldman, N. Amer. Fauna, **31**, 1910, pp. 93, 94; Mus. Vert. Zool.).

Neotoma cinerea cinerea (Ord)

Gray Bushy-tailed Wood Rat

Original description—"*Mus cinereus* Ord, Guthrie's Geog., 2nd Amer. ed., **2**, 1815, p. 292."

Type locality—Great Falls, Cascade County, Montana (*fide* Goldman, N. Amer. Fauna, **31**, 1910, p. 95).

Synonyms—*Teonoma cinerea acraia* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, pp. 247, 248 (type really from Jordan Hot Springs, near Kern River, Sierra Nevada, Tulare County, California); *Teonoma cinerea.*

Range—High Transition and Boreal zones along the central and southern Sierra Nevada from Nevada County south as far as Jackass Meadow (near Kern County line), Tulare County; also on the White and Inyo mountains, Mono and Inyo counties (Goldman, N. Amer. Fauna, **31**, 1910, pp. 96, 98; Mus. Vert. Zool.).

Neotoma cinerea occidentalis Baird

Western Bushy-tailed Wood Rat

Original description—*Neotoma occidentalis* (Cooper, MS) Baird, Proc. Acad. Nat. Sci. Phila., **7**, 1855, p. 335.

Type locality—Shoalwater Bay, Pacific County, Washington.

Synonym—*Teonoma cinerea occidentalis.*

Range—Transition and Boreal zones of the northern end of the state; west nearly to the sea-coast north of Humboldt Bay; east to the Warner Mountains, Modoc County; south along the inner coast ranges as far as mountains near Elk Creek, Glenn County, and along the Sierra Nevada through Plumas County (Goldman, N. Amer. Fauna, **31**, 1910, p. 102; Mus. Vert. Zool.).

Phenacomys orophilus Merriam

Mountain Lemming Mouse

Original description—*Phenacomys orophilus* Merriam, N. Amer. Fauna, **5**, July, 1891, p. 66.

Type locality—Near head of Timber Creek, 10,500 feet altitude, Salmon River Mountains, Idaho.

Range—Known only from three specimens taken in the Boreal zone on Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 95), and one specimen taken at about 7500 feet altitude near Pyramid Peak, Eldorado County (Elliot, Field Col. Mus., zool. ser., **1**, 1898, p. 204).

Phenacomys albipes Merriam

White-footed Lemming Mouse

Original description—*Phenacomys albipes* Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, pp. 125, 126.

Type locality—Redwoods near Arcata, Humboldt County, California.

Range—The type specimen, taken in northwest humid Boreal, as above, represents the only locality of occurrence so far known.

Phenacomys longicaudus True

Long-tailed Lemming Mouse

Original description—*Phenacomys longicaudus* True, Proc. U. S. Nat. Mus., **13**, 1890, pp. 303, 304.

Type locality—Marshfield, Coos County, Oregon.

Range—One record for the state: one specimen found dead in a road near Mount Sanhedrin (Transition zone), Mendocino County (Stone, Proc. Acad. Nat. Sci. Phila., July, 1904, p. 578).

Evotomys mazama Merriam

Mazama Red-backed Mouse

Original description—*Evotomys mazama* Merriam, Proc. Biol. Soc. Wash., **11**, April 21, 1897, pp. 71, 72.

Type locality—Crater Lake, Klamath County, Oregon.

Range—Boreal zone on Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 95).

Evotomys obscurus Merriam

Dusky Red-backed Mouse

Original description—*Evotomys obscurus* Merriam, Proc. Biol. Soc. Wash., **11**, April 21, 1897, p. 72.

Type locality—Prospect, upper Rogue River Valley, Jackson County, Oregon.

Range—Boreal zone of northwestern California east of the humid coast belt and west of the main Sierran divide: Trinity Mountains (Jackson and Castle lakes, Siskiyou County) east to Carberry Ranch (near Montgomery Creek), Shasta County (Bailey, Proc. Biol. Soc. Wash., 11, 1897, p. 133; Mus. Vert. Zool.).

Evotomys californicus Merriam

California Red-backed Mouse

Original description—*Evotomys californicus* Merriam, N. Amer. Fauna, 4, October, 1890, p. 26.

Type locality—Eureka, Humboldt County, California.

Range—Boreal zone in the humid northwest coast belt, chiefly in the redwood forests, south as far as Willits, Mendocino County, interiorly to Fair Oaks, Humboldt County (Bailey, Proc. Biol. Soc. Wash., 11, 1897, p. 134; Mus. Vert. Zool.).

Microtus montanus montanus (Peale)

Peale Meadow Mouse

Original description—*Arvicola montana* Peale, U. S. Exploring Exped., 8, 1848, pp. 44, 45.

Type locality—Headwaters of Sacramento River, near Mount Shasta, California (*fide* Bailey, N. Amer. Fauna, 17, 1900, p. 27).

Synonyms—*Arvicola longirostris* Baird, Pac. R. R. Rep., 8, 1857, pp. 530, 531 (type from upper Pitt River, California); Peale Vole.

Range—Upper Sonoran and Transition zones in the Modoc region, west to Sisson, Siskiyou County, and south along the Sierra Nevada at least to the Yosemite Valley (Bailey, *supra cit.*, p. 28; Mus. Vert. Zool.).

Microtus montanus dutcheri Bailey

Mount Whitney Meadow Mouse

Original description—*Microtus dutcheri* Bailey, Proc. Biol. Soc. Wash., 12, April 30, 1898, p. 85.

Type locality—Big Cottonwood Meadows, 10,000 feet altitude, near Mount Whitney, Inyo County, California.

Synonym—Dutcher Vole.

Range—Boreal zone of the extreme southern Sierra Nevada, in vicinity of Mount Whitney; south to Jackass Meadow, Tulare County, north to head of San Joaquin River, Fresno County (Bailey, N. Amer. Fauna, 17, 1900, p. 33; Mus. Vert. Zool.).

Microtus californicus californicus (Peale)

California Meadow Mouse

Original description—*Arvicola californica* Peale, U. S. Exploring Exped., 8, 1848, p. 46, "pl. 11, fig. 2."

Type locality—San Francisco Bay, California.

Synonyms—*Arvicola trowbridgii* Baird, Pac. R. R. Rep., 8, 1857, p. 529 (type from Monterey, California); *Arvicola montana,* part; California Vole; *Microtus edax,* part.

Range—Both Sonoran and Transition zones throughout the state west of the Sierra Nevada and desert divides, including the San Diegan district, from the Mexican line north to the Oregon line, and east at the north to Shasta Valley, centrally to Onyx, Kern County; *except* bed of San Joaquin-Sacramento Valley, and narrow coast strip in vicinity of Cape Mendocino (Bailey, N. Amer. Fauna, 17, 1900, p. 35; Mus. Vert. Zool.).

Microtus californicus vallicola Bailey

Owens Valley Meadow Mouse

Original description—*Microtus californicus vallicola* Bailey, Proc. Biol. Soc. Wash., 12, April 30, 1898, p. 89.

Type locality—Lone Pine, Inyo County, California.

Synonym—Valley Vole.

Range—Suitable parts of Upper and Lower Sonoran zones on the Mohave desert and in the Inyo region; south to Victorville, San Bernardino County, east to Panamint Mountains, and north through Owens Valley to Alvord (Bailey, N. Amer. Fauna, 17, 1900, p. 36; Mus. Vert. Zool.).

Microtus californicus constrictus Bailey

Mendocino Meadow Mouse

Original description — *Microtus californicus constrictus* Bailey, N. Amer. Fauna, 17, June, 1900, pp. 36, 37.

Type locality—Cape Mendocino, near Capetown, Humboldt County, California.

Synonym—Coast Vole, part.

Range—Transition zone in northwest humid coast belt, at least from Capetown to Eureka and interiorly to Cuddeback and Fair Oaks; all these localities in Humboldt County (Mus. Vert. Zool.).

Microtus edax (Le Conte)

Tule Meadow Mouse

Original description—*Arvicola edax* Le Conte, Proc. Acad. Nat. Sci. Phila., **6**, October, 1853, p. 405.

Type locality—California, somewhere south of San Francisco (*fide* Baird, Pac. R. R. Rep., **8**, 1857, p. 532).

Synonym—Tule Vole.

Range—Lower and Upper Sonoran zones in suitable parts of San Joaquin and Sacramento valleys, north to near Marysville Buttes, south to Tulare Lake, and west to Cordelia Slough, Solano County (Bailey, N. Amer. Fauna, **17**, 1900, p. 38; Mus. Vert. Zool.).

Microtus scirpensis Bailey

Amargosa Meadow Mouse

Original description—*Microtus scirpensis* Bailey, N. Amer. Fauna, **17**, June, 1900, p. 38.

Type locality—Amargosa River (near Nevada line), Inyo County, California.

Synonym—Desert Vole.

Range—Known only from a small tule marsh, Lower Sonoran zone, at the type locality, as above.

Microtus mordax mordax (Merriam)

Cantankerous Meadow Mouse

Original description—*Arvicola mordax* Merriam, N. Amer. Fauna, **5**, July, 1891, pp. 61, 62.

Type locality—Sawtooth (or Alturas) Lake, east foot of Sawtooth Mountains, Idaho.

Synonym—Cantankerous Vole.

Range—Transition and Boreal zones along the whole Sierra Nevada, south to Taylor Meadow, Tulare County (close to Kern County line); also on White Mountains, Inyo County;

west in northern California to Trinity and Salmon Mountains, east to Warner Mountains (Bailey, N. Amer. Fauna, **17**, 1900, p. 50; Mus. Vert. Zool.).

Microtus mordax bernardinus Merriam

San Bernardino Meadow Mouse

Original description—*Microtus mordax bernardinus* Merriam, Proc. Biol. Soc. Wash., **21**, June 9, 1908, p. 145.

Type locality—Dry Lake, 9000 feet altitude, San Bernardino Mountains, California.

Range—High Transition and Boreal zones in the San Bernardino Mountains, San Bernardino County, California (Merriam, *supra cit.;* Mus. Vert. Zool.).

Microtus mordax angusticeps Bailey

Northwest Coast Meadow Mouse

Original description—*Microtus angusticeps* Bailey, Proc. Biol. Soc. Wash., **12**, April 30, 1898, p. 86.

Type locality—Crescent City, Del Norte County, California.

Synonym—Coast Vole, part.

Range—Transition and Boreal zones in extreme northwest humid coast belt; south to Eureka, Humboldt County (Bailey, N. Amer. Fauna, **17**, 1900, p. 52; Mus. Vert. Zool.).

Microtus oregoni oregoni (Bachman)

Oregon Meadow Mouse

Original description—*Arvicola oregoni* Bachman, Journ. Acad. Nat. Sci. Phila., **8**, 1839, pp. 60, 61.

Type locality—Astoria, Oregon.

Synonym—Oregon Vole.

Range—Transition and Boreal zones in extreme northwest humid coast belt, south to Dyerville, Humboldt County, and interiorly to Hoopa Valley (Bailey, N. Amer. Fauna, **17**, 1900, p. 71; Mus. Vert. Zool.).

Microtus oregoni adocetus Merriam

Yolla Bolly Meadow Mouse

Original description—*Microtus oregoni adocetus* Merriam, Proc. Biol. Soc. Wash., **21**, June 9, 1908, pp. 145, 146.

Type locality—South Yolla Bolly Mountain, Trinity County, California.

Range—As far as known, only in Boreal zone at the type locality, as above.

Lagurus curtatus (Cope)

Short-tailed Meadow Mouse

Original description—*Arvicola curtata* Cope, Proc. Acad. Nat. Sci. Phila., 1868, p. 2.

Type locality—Pigeon Spring, Mount Magruder, Nevada, near California boundary line.

Synonym—Short-tailed Vole; *Microtus curtatus.*

Range—Transition zone on the arid mountains in the Inyo region; Inyo and White mountains (Bailey, N. Amer. Fauna, 17, 1900, pp. 67, 68).

Fiber zibethicus mergens Hollister

Nevada Muskrat

Original description—*Fiber zibethicus mergens* Hollister, Proc. Biol. Soc. Wash., **23**, February 2, 1910, p. 1.

Type locality—Fallon, Churchill County, Nevada.

Synonym—*Ondatra zibethica mergens.*

Range—Extreme eastern part of Modoc region: Eagle Lake and Susanville, Lassen County (Hollister, N. Amer. Fauna, **32**, 1911, pp. 27, 28).

Fiber zibethicus pallidus Mearns

Pallid Muskrat

Original description—*Fiber zibethicus pallidus* Mearns, Bull. Amer. Mus. Nat. Hist., **2**, February, 1890, p. 280.

Type locality—Old Fort Verde (Camp Verde), Yavapai County, Arizona.

Synonym—*Ondatra zibethica pallida.*

Range—Colorado River and tributary sloughs, from the Nevada line to the Mexican boundary; also irrigation canals in the Imperial Valley, Imperial County (Mus. Vert. Zool.; Hollister, N. Amer. Fauna, **32**, 1911, pp. 28, 29).

Epimys norvegicus (Erxleben)

Norway Rat

Original description—"*Mus norvegicus* Erxleben, Syst. Regni Anim., 1, 1777, p. 381."

Type locality—"Norway."

Synonyms—Brown Rat, part; Wharf Rat; *Mus decumanus.*

Range—Almost everywhere in the settled portions of the state, chiefly in towns and cities. In the San Joaquin and Sacramento valleys, rats have invaded marshy tracts and occur along sloughs far from human habitations. This is the most abundant species of non-native mammal outside of the house mouse.

Epimys rattus (Linnaeus)

Black Rat

Original description—*Mus rattus* Linnaeus, Syst. Nat.,1, 1758, p. 61.

Type locality—Sweden.

Range—Occurs in relatively small numbers in San Francisco and neighboring cities of the San Francisco Bay region. Not native.

Epimys alexandrinus (Geoffroy)

Roof Rat

Original description—"*Mus alexandrinus* Geoffroy, Description de l'Egypte, Mammifères, 1818, p. 733."

Type locality—"Alexandria, Egypt."

Synonym—Brown Rat, part.

Range—Occurs commonly in the larger cities of west-central California. Not native.

Mus musculus musculus Linnaeus

House Mouse

Original description—*Mus musculus* Linnaeus, Syst. Nat., 1, 1758, p. 62.

Type locality—Sweden.

Range—Practically throughout the state around human settlements; in the thickest settled valleys occurs widely over uncultivated land, often a mile or more from the nearest build-

ing. An immigrant from Europe. In west-central California a variation has appeared, of possible phylogenetic importance (Dice, Science, n. s., 35, 1912, pp. 834–836).

Family GEOMYIDAE

Thomomys bottae bottae (Eydoux and Gervais)

California Pocket Gopher

Original description—"*Oryctomys (Saccophorus) bottae* Eydoux and Gervais, Mag. de Zool., 6, 1836, p. 23, pl. 21."

Type locality—Coast of California: Monterey (see Allen, Bull. Amer. Mus. Nat. Hist., 5, 1893, p. 57).

Synonyms—*Thomomys talpoides bulbivorus; Thomomys bulbivorus.*

Range—Upper Sonoran and Transition zones in the San Francisco Bay region, south along the coast to Ventura County, and north at least through Marin County; east into Contra Costa County (Mus. Vert. Zool.).

Thomomys bottae pallescens Rhoads

San Diego Pocket Gopher

Original description—*Thomomys bottae pallescens* Rhoads, Proc. Acad. Nat. Sci. Phila., March 19, 1895, p. 36.

Type locality—Grapelands, San Bernardino County, California.

Synonym—Southern Pocket Gopher.

Range—Lower and Upper Sonoran zones in the San Diegan district, from the Mexican line northwest into Ventura County (Mus. Vert. Zool.).

Thomomys bottae laticeps Baird

Humboldt Bay Pocket Gopher

Original description—*Thomomys laticeps* Baird, Proc. Acad. Nat. Sci. Phila., 7, April, 1855, p. 335.

Type locality—Humboldt Bay, Humboldt County, California.

Synonyms—*Thomomys bottae,* part; Broad-headed Pocket Gopher.

Range—Transition zone in the humid coast belt in the vicinity of Humboldt Bay (Mus. Vert. Zool.).

Thomomys angularis angularis Merriam

Los Baños Pocket Gopher

Original description—Thomomys angularis Merriam, Proc. Biol. Soc. Wash., **11**, July 15, 1897, p. 214.

Type locality—Los Baños, Merced County, California.

Synonym—San Joaquin Pocket Gopher.

Range—Lower and Upper Sonoran zones on west side of San Joaquin Valley, at least from Los Baños, Merced County, north to Tracy, San Joaquin County (Mus. Vert. Zool.).

Thomomys angularis pascalis Merriam

Fresno Pocket Gopher

Original description—Thomomys angularis pascalis Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, p. 111.

Type locality—Fresno, San Joaquin Valley, California.

Range—Lower Sonoran zone in the southern San Joaquin Valley, from the vicinity of Bakersfield north at least to Fresno, and west as far as the Carrizo Plain, San Luis Obispo County (Mus. Vert. Zool.).

Thomomys mewa Merriam

Digger Pine Pocket Gopher

Original description—Thomomys mewa Merriam, Proc. Biol. Soc. Wash., **21**, June 9, 1908, p. 146.

Type locality—Raymond, Madera County, California.

Range—Digger Pine belt, in the Upper Sonoran zone, along the west base of the Sierra Nevada at least from Placer County south to Kern County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Thomomys leucodon navus Merriam

Red Bluff Pocket Gopher

Original description—Thomomys leucodon navus Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, p. 112.

Type locality—Red Bluff, Tehama County, California.

Range—Upper and Lower Sonoran zones in the Sacramento Valley.

Thomomys fuscus fisheri Merriam

Fisher Pocket Gopher

Original description—*Thomomys fuscus fisheri* Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, pp. 111, 112.

Type locality—Beckwith, Sierra Valley, Plumas County, California.

Range—Upper Sonoran and Transition zones in the Modoc region of northeastern California.

Thomomys operarius Merriam

Owens Lake Pocket Gopher

Original description—*Thomomys operarius* Merriam, Proc. Biol. Soc. Wash., **11**, July 15, 1897, pp. 215, 216.

Type locality—Keeler, Owens Lake, Inyo County, California.

Synonym—Owens Valley Pocket Gopher.

Range—Lower Sonoran zone; restricted to the immediate vicinity of Owens Lake (Elliot, Field. Col. Mus., zool. ser., **3**, 1904, p. 300; Mus. Vert. Zool.).

Thomomys scapterus Elliot

Panamint Pocket Gopher

Original description—*Thomomys scapterus* Elliot, Field. Col. Mus., zool. ser., 3, December, 1903, pp. 248, 249.

Type locality—Hannopee Canyon, Panamint Mountains, Inyo County, California.

Range—Upper Sonoran (?) zone in the Panamint Mountains, Inyo County (Elliot, Field Col. Mus., zool. ser., **3**, 1904, p. 301).

Thomomys aureus perpes Merriam

Lone Pine Pocket Gopher

Original description—*Thomomys aureus perpes* Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, p. 111.

Type locality—Lone Pine, Owens Valley, Inyo County, California.

Synonyms—*Thomomys perpallidus perpes; Thomomys perpallidus*, part; Golden Pocket Gopher.

Range—Lower and Upper Sonoran zones on the Mohave Desert, north through the Inyo region, south to north base of San Bernardino Mountains, west to Antelope Valley, in northern Los Angeles County (Mus. Vert. Zool.).

Thomomys albatus Grinnell

Imperial Valley Pocket Gopher

Original description—*Thomomys albatus* Grinnell, Univ. Calif. Publ. Zool., **10**, June 7, 1912, pp. 172, 173.

Type locality—California side of lower Colorado River at the old Hanlon Ranch, near Pilot Knob, Imperial County.

Synonyms—*Thomomys fulvus,* part; *Thomomys perpallidus,* part.

Range—Lower Sonoran zone in the delta area on the Colorado Desert in Imperial County, from near Pilot Knob west to Carrizo Creek and north to Salton Sea (Grinnell, *supra cit.,* pp. 173, 174).

Thomomys perpallidus Merriam

Palm Springs Pocket Gopher

Original description—*Thomomys talpoides perpallidus* Merriam, Science, **8**, December 24, 1886, p. 588.

Type locality—Palm Springs, Riverside County, California (see Stephens, Calif. Mammals, 1906, p. 138).

Synonyms—*Thomomys fulvus perpallidus;* Pallid Pocket Gopher; Pale-colored Gopher.

Range—Lower Sonoran zone at extreme northwest border of Colorado Desert in vicinity of Palm Springs, Riverside County (Grinnell, Univ. Calif. Publ. Zool., **10**, 1912, p. 173).

Thomomys cabezonae Merriam

Cabezon Pocket Gopher

Original description—*Thomomys cabezonae* Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, p. 110.

Type locality—Cabezon, San Gorgonio Pass, Riverside County, California.

Range—Lower and Upper Sonoran zones in San Gorgonio Pass and adjacent foothills, Riverside County (Mus. Vert. Zool.).

Thomomys nigricans Rhoads

Tawny Pocket Gopher

Original description—*Thomomys fulvus nigricans* Rhoads, Proc. Acad. Nat. Sci. Phila., March 19, 1895, p. 36.

Type locality—Witch Creek, San Diego County, California.

Synonym—*Thomomys fulvus,* part; Dark-colored Gopher.

Range—Upper Sonoran and lower Transition zones in the San Diegan district, from near the Mexican line north to the west side of the San Jacinto Mountains (Mus. Vert. Zool.).

Thomomys altivallis Rhoads

San Bernardino Mountain Pocket Gopher

Original description—*Thomomys altivallis* Rhoads, Proc. Acad. Nat. Sci. Phila., March 19, 1895, pp. 34, 35.

Type locality—San Bernardino Mountains, 5000 feet altitude, San Bernardino County, California.

Range—Transition and Boreal zones on the San Bernardino and San Jacinto mountains, San Bernardino and Riverside counties (Mus. Vert. Zool.).

Thomomys alpinus alpinus Merriam

Mount Whitney Pocket Gopher

Original description—*Thomomys alpinus* Merriam, Proc. Biol. Soc. Wash., **11**, July 15, 1897, p. 216.

Type locality—Cottonwood Meadows, 10,000 feet altitude, 8 miles southeast of Mount Whitney, in Inyo County, California.

Synonym—Alpine Pocket Gopher.

Range—Transition and Boreal zones in the southern Sierra Nevada, from Taylor Meadow (near Kern County line), Tulare County, north at least to head of Kern River, Tulare County; ranging also down on the adjacent east slopes, in Inyo County (Mus. Vert. Zool.).

Thomomys alpinus awahnee Merriam

Yosemite Pocket Gopher

Original description—*Thomomys alpinus awahnee* Merriam, Proc. Biol. Soc. Wash., **21**, June 9, 1908, pp. 146, 147.

Type locality—Yosemite Valley, Mariposa County, California.

Range—As far as known, Transition zone in Yosemite Valley (Merriam, *supra cit.;* Mus. Vert. Zool.).

Thomomys monticola Allen

Sierra Nevada Pocket Gopher

Original description—*Thomomys monticola* Allen, Bull. Amer. Mus. Nat. Hist., **5**, April 28, 1893, p. 48.

Type locality—Mount Tallac, 7500 feet altitude, Eldorado County, California.

Synonyms—Mountain Pocket Gopher; Pine Woods Gopher; *Thomomys monticola pinetorum* Merriam, N. Amer. Fauna, **16**, October, 1899, p. 97 (type from Sisson, Siskiyou County, California).

Range—Transition and Boreal zones on the northern Sierra Nevada, from the Tahoe region north to Mount Shasta, thence west through the Trinity Mountains (Mus. Vert. Zool.).

Family HETEROMYIDAE

Perognathus panamintinus panamintinus Merriam

Panamint Pocket Mouse

Original description—*Perognathus longimembris panamintinus* Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, p. 265.

Type locality—Perognathus Flat, altitude 5200 feet, Panamint Mountains, Inyo County, California.

Range—Upper Sonoran zone on the Panamint Mountains, Inyo County (Osgood, N. Amer. Fauna, **18**, 1900, pp. 28, 29).

Perognathus panamintinus bangsi Mearns

Bangs Pocket Mouse

Original description—*Perognathus longimembris bangsi* Mearns, Bull. Amer. Mus. Nat. Hist., **10**, August 31, 1898, p. 300.

Type locality—Palm Springs, Colorado Desert, Riverside County, California.

Synonyms—Perognathus panamintinus arenicola Stephens, Proc. Biol. Soc. Wash., **13**, June 13, 1900, p. 153 (type from San Felipe Narrows, eastern San Diego County, California); *Perognathus pericalles* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, pp. 252, 253 (type from Keeler, Inyo County, California).

Range—Lower Sonoran and low Upper Sonoran zones in the Colorado and Mohave desert region, west to the eastern margin of the San Diegan district, and north through the Inyo region to the head of Owens Valley (Osgood, N. Amer. Fauna, **18**, 1900, pp. 29, 30; Mus. Vert. Zool.).

Perognathus panamintinus brevinasus Osgood

Short-nosed Pocket Mouse

Original description—Perognathus panamintinus brevinasus Osgood, N. Amer. Fauna, **18**, September, 1900, p. 30.

Type locality—San Bernardino, San Bernardino County, California.

Synonym—Perognathus longimembris, part.

Range—Lower Sonoran, and low Upper Sonoran zones in the San Diegan district, from the Mexican line northwest at least to San Fernando Valley, Los Angeles County (Osgood, *supra cit.*, p. 31; Mus. Vert. Zool.).

Perognathus elibatus Elliot

Mount Pinos Pocket Mouse

Original description—Perognathus elibatus Elliot, Field Col. Mus., zool. ser., 3, December, 1903, p. 252.

Type locality—Lockwood Valley, altitude 5500 feet, near Mount Pinos, Ventura County, California.

Range—Upper Sonoran zone, in Lockwood Valley, near Mount Pinos, Ventura County (Elliot, *supra cit.; also ibid.*, March, 1904, p. 307).

Perognathus pacificus Mearns

Pacific Pocket Mouse

Original description—Perognathus pacificus Mearns, Bull. Amer. Mus. Nat. Hist., **10**, August 31, 1898, p. 299.

August 26, 1913.

Type locality—Mexican boundary monument no. 258, shore of Pacific Ocean, near Tia Juana, San Diego County, California.

Range—Apparently Upper Sonoran zone close to the ocean shore; known only from the type locality, and from a similar place in the extreme northwestern corner of San Diego County (Stephens, Calif. Mammals, 1906, p. 165).

Perognathus bombycinus Osgood

Yuma Pocket Mouse

Original description—*Perognathus bombycinus* Osgood, Proc. Biol. Soc. Wash., **20**, February 23, 1907, pp. 19, 20.

Type locality—Yuma, Arizona.

Range—Lower Sonoran zone in extreme southeastern corner of Imperial County: vicinity of Pilot Knob (Mus. Vert. Zool.).

Perognathus longimembris longimembris (Coues)

San Joaquin Pocket Mouse

Original description—*Otognosis longimembris* Coues, Proc. Acad. Nat. Sci. Phila., August, 1875, p. 305.

Type locality—Fort Tejon, Kern County, California.

Synonyms—*Perognathus inornatus* Merriam, N. Amer. Fauna, **1**, October, 1889, p. 15 (type from Fresno, California); *Cricetodipus parvus; Perognathus parvus.*

Range—Sonoran zones in the San Joaquin and Sacramento valleys, from Fort Tejon, Kern County, north to Sites, Colusa County (Mus. Vert. Zool.; Taylor, Univ. Calif. Publ. Zool., **10**, 1912, pp. 156, 162).

Perognathus longimembris neglectus Taylor

McKittrick Pocket Mouse

Original description—*Perognathus longimembris neglectus* Taylor, Univ. Calif. Publ. Zool., **10**, May 21, 1912, p. 155.

Type locality—McKittrick, Kern County, California.

Range—Lower Sonoran zone on west side of southern San Joaquin Valley: vicinity of McKittrick, Kern County, and Simmler, Carrizo Plain, San Luis Obispo County (Mus. Vert. Zool.).

Perognathus parvus mollipilosus Coues

Coues Pocket Mouse

Original description—Perognathus mollipilosus Coues, Proc. Acad. Nat. Sci. Phila., August 1875, p. 296.

Type locality—Fort Crook (about 2 miles northeast of Burgettville), Shasta County, California.

Synonym—Perognathus monticola.

Range—Upper Sonoran, Transition, and lower Boreal zones in the Modoc region, from Mount Shasta and vicinity east to the Warner Mountains, and south to Vinton, Plumas County (Osgood, N. Amer. Fauna, **18**, 1900, p. 37; Mus. Vert. Zool.).

Perognathus parvus olivaceus Merriam

Great Basin Pocket Mouse

Original description—Perognathus olivaceus Merriam, N. Amer. Fauna, **1**, October, 1889, pp. 15, 16.

Type locality—Kelton, Boxelder County, Utah.

Range—Upper Sonoran and lower Transition zones east of the Sierra Nevada, from Long Valley, Mono County, south to foothills due west of Independence, Inyo County; also at Lower Alkali Lake, extreme eastern border of Modoc County (Osgood, N. Amer. Fauna, **18**, 1900, p. 38; Mus. Vert. Zool.).

Perognathus parvus magruderensis Osgood

Mount Magruder Pocket Mouse

Original description—Perognathus parvus magruderensis Osgood, N. Amer. Fauna, **18**, September, 1900, p. 38.

Type locality—Mount Magruder, 8000 feet altitude, Esmeralda County, Nevada.

Range—Upper Sonoran and Transition zones on the desert ranges of the Inyo region, from the White Mountains south to the Panamint and Coso ranges (Osgood, *supra cit.;* Mus. Vert. Zool.).

Perognathus xanthonotus Grinnell

Walker Pass Pocket Mouse

Original description—Perognathus xanthonotus Grinnell, Proc. Biol. Soc. Wash., **25**, July 31, 1912, pp. 127, 128.

Type locality—Freeman Canyon, 4900 feet altitude, east slope of Walker Pass, Kern County, California.

Range—Tree-yucca belt (high Lower Sonoran and low Upper Sonoran zones) in vicinity of Walker Pass, Kern County (Mus. Vert. Zool.).

Perognathus alticola Rhoads

White-eared Pocket Mouse

Original description—*Perognathus alticolus* Rhoads, Proc. Acad. Nat. Sci. Phila., December, 1893, p. 412.

Type locality—Squirrel Inn, near Little Bear Valley, San Bernardino Mountains, San Bernardino County, California.

Range—Known only from the lower Transition zone in the near vicinity of the type locality (Stephens, Calif. Mammals, 1906, p. 166).

Perognathus baileyi baileyi Merriam

Bailey Pocket Mouse

Original description—*Perognathus baileyi* Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, pp. 262, 263.

Type locality—Magdalena, Sonora, Mexico.

Range—Agave belt of Upper Sonoran zone at Mountain Spring, near Mexican boundary, San Diego County (Mus. Vert. Zool.).

Perognathus formosus Merriam

Long-tailed Pocket Mouse

Original description—*Perognathus formosus* Merriam, N. Amer. Fauna, 1, October, 1889, pp. 17, 18.

Type locality—St. George, Washington County, Utah.

Synonym—*Perognathus mesembrinus* Elliot, Field. Col. Mus., zool. ser., 3, December, 1903, p. 251 (type from Palm Springs, Colorado Desert, Riverside County, California).

Range—Upper and Lower Sonoran zones in portions of the Mohave desert region; northwest through the Inyo region at least to Lone Pine and the Inyo Mountains; southwest to the north base of the San Bernardino Mountains and to La Puerta, eastern San Diego County; southeast to the Colorado River at Pilot Knob, Imperial County (Mus. Vert. Zool.; Osgood, N. Amer. Fauna, **18**, 1900, p. 41).

Perognathus penicillatus penicillatus Woodhouse

Colorado Desert Pocket Mouse

Original description—Perognathus penicillatus Woodhouse, Proc. Acad. Nat. Sci. Phila., **6**, December, 1852, pp. 200, 201.

Type locality—Somewhere near San Francisco Mountain, Arizona, possibly Little Colorado Desert (see Osgood, N. Amer. Fauna, **18**, 1900, p. 45).

Synonym—Perognathus penicillatus angustirostris Osgood, *supra cit.*, p. 47 (type from Carrizo Creek, western edge of Colorado Desert, Imperial County, California).

Range—Lower Sonoran zone on Colorado Desert, west to La Puerta, eastern San Diego County, northwest to Cabezon, Riverside County, and north along the Colorado River bottom to Needles (Mus. Vert. Zool.).

Perognathus penicillatus stephensi Merriam

Stephens Pocket Mouse

Original description—Perognathus stephensi Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, p. 267.

Type locality—Mesquite Valley, northwest arm of Death Valley, Inyo County, California.

Range—Lower Sonoran zone on the Mohave Desert: Death Valley, Inyo County, south to Victorville, San Bernardino County (Elliot, Field Col. Mus., zool. ser., **3**, 1904, p. 309; Mus. Vert. Zool.).

Perognathus fallax fallax Merriam

San Diego Short-eared Pocket Mouse

Original description—Perognathus fallax Merriam, N. Amer. Fauna, **1**, October, 1889, pp. 19, 20.

Type locality—Reche Canyon, 3 miles southeast of Colton, San Bernardino County, California (*fide* Osgood, N. Amer. Fauna, **18**, 1900, p. 55).

Range—Lower Sonoran zone in southern part of the San Diegan district, from the Mexican line northwest at least to the vicinity of Riverside (Mus. Vert. Zool.).

Perognathus fallax pallidus Mearns

Pallid Short-eared Pocket Mouse

Original description—*Perognathus fallax pallidus* Mearns, Proc. Biol. Soc. Wash., 14, August 9, 1901, pp. 135, 136.

Type locality—Mountain Spring, east slope of coast range near Mexican boundary, in San Diego County, California.

Range—Lower Sonoran zone along western rim of Colorado and Mohave deserts, from the Mexican line northwest at least to Victorville; in other words, east slope of main mountain divides in San Diego, Riverside and San Bernardino counties (Mus. Vert. Zool.).

Perognathus californicus californicus Merriam

California Pocket Mouse

Original description—*Perognathus californicus* Merriam, N. Amer. Fauna, 1, October, 1889, p. 26.

Type locality—Berkeley, Alameda County, California.

Synonyms—*Perognathus armatus* Merriam, *supra cit.*, p. 27 (type from Mount Diablo, Contra Costa County, California); *Perognathus californicus dispar* Osgood, N. Amer. Fauna, 18, 1900, p. 58 (type from Carpinteria, Santa Barbara County, California), part.

Range—Upper Sonoran zone in west central California, south of Golden Gate and Strait of Carquinez; south through the northern part of the San Diegan district at least to and including Los Angeles County; also western foothills of southern Sierra Nevada north at least to Raymond, Madera County (Mus. Vert. Zool.; Osgood, *supra cit.*, p. 59).

Perognathus californicus ochrus Osgood

Kern County Pocket Mouse

Original description—*Perognathus californicus ochrus* Osgood, Proc. Biol. Soc. Wash., 17, June 9, 1904, p. 128.

Type locality—Santiago Springs, 16 miles southwest of McKittrick, Kern County, California.

Synonym—*Perognathus californicus dispar*, part.

Range—Lower Sonoran zone in the southern San Joaquin Valley, west to Cuyama Valley, and north to Alcalde, Fresno County (Osgood, *supra cit.*).

Perognathus californicus femoralis Allen

Dulzura Pocket Mouse

Original description—*Perognathus femoralis* Allen, Bull. Amer. Mus. Nat. Hist., 3, June 30, 1891, p. 281.

Type locality—Dulzura, San Diego County, California.

Synonym—*Perognathus californicus dispar*, part; Great California Pocket Mouse.

Range—High Upper Sonoran zone in the San Diegan district, from the Mexican line north to the southwest slopes of the San Bernardino Mountains (Mus. Vert. Zool.).

Perognathus spinatus spinatus Merriam

Spiny Pocket Mouse

Original description—*Perognathus spinatus* Merriam, N. Amer. Fauna, 1, October, 1889, p. 21.

Type locality—California side of the Colorado River, 25 miles below The Needles, San Bernardino County.

Range—Lower Sonoran zone on hilly parts of the Colorado desert, from the Mexican line northwest to Palm Springs, Riverside County, and along the Colorado River to near Needles (Osgood, N. Amer. Fauna, 18, 1900, p. 60; Mus. Vert. Zool.).

Perodipus agilis agilis (Gambel)

Gambel Kangaroo Rat

Original description—*Dipodomys agilis* Gambel, Proc. Acad. Nat. Sci. Phila., 4, August, 1848, pp. 77, 78.

Type locality—Los Angeles, Los Angeles County, California.

Synonyms—Gambel Pocket Rat; *?Dipodomys heermanni* Le Conte, Proc. Acad. Nat. Sci. Phila., January, 1853, p. 224 (type taken by Heermann in the "Sierra Nevada"—possibly Fort Tejon); *?Dipodomys wagneri* Le Conte, *l. c.* (no locality; possibly not from California).

Range—Upper and Lower Sonoran zones in the San Diegan district, from the Mexican line northwest at least into Ventura County (Mus. Vert. Zool.).

Perodipus agilis tularensis Merriam

Tulare Kangaroo Rat

Original description—Perodipus agilis tularensis Merriam, Proc. Biol. Soc. Wash., 17, July 14, 1904, p. 143.

Type locality—Alila (=Earlimart), Tulare County, California.

Range—Lower Sonoran zone in the southern San Joaquin Valley, at least from near Bakersfield northwest to Los Baños, Merced County; west to Carrizo Plain and Cuyama Valley, San Luis Obispo County (Mus. Vert. Zool.).

Perodipus perplexus Merriam

Walker Basin Kangaroo Rat

Original description—Perodipus perplexus Merriam, Proc. Biol. Soc. Wash., **20**, July 22, 1907, p. 79.

Type locality—Walker Basin, Kern County, California.

Range—Upper Sonoran zone of the foothills and small interior valleys of the southern Sierra and Tejon Mountains, from Walker Basin to Tejon Pass (Merriam, *supra cit.*).

Perodipus morroensis Merriam

Morro Kangaroo Rat

Original description—Perodipus morroensis Merriam, Proc. Biol. Soc. Wash., **20**, July 22, 1907, pp. 78, 79.

Type locality—Morro, San Luis Obispo County, California.

Range—Known only from the original description, as above.

Perodipus goldmani Merriam

Goldman Kangaroo Rat

Original description—Perodipus goldmani Merriam, Proc. Biol. Soc. Wash., 17, July 14, 1904, p. 143.

Type locality—Salinas, mouth of Salinas Valley, Monterey County, California.

Range—Known only from the type locality, as above.

Perodipus venustus Merriam

Santa Cruz Kangaroo Rat

Original description—*Perodipus venustus* Merriam, Proc. Biol. Soc. Wash., 17, July 14, 1904, p. 142.

Type locality—Santa Cruz, Santa Cruz County, California.

Synonym—Santa Cruz Pocket Rat.

Range—Upper Sonoran zone south from San Francisco Bay through the Santa Cruz district at least to the Santa Lucia Mountains, Monterey County (Merriam, *supra cit.*; Mus. Vert. Zool.).

Perodipus streatori streatori Merriam

Streator Kangaroo Rat

Original description—*Perodipus streatori* Merriam, Proc. Biol. Soc. Wash., 9, July 21, 1894, pp. 113, 114.

Type locality—Carbondale, Amador County, California.

Synonym—Streator Pocket Rat.

Range—Upper Sonoran zone along lower west slope of central Sierra Nevada.

Perodipus streatori simulans Merriam

Dulzura Kangaroo Rat

Original description—*Perodipus streatori simulans* Merriam, Proc. Biol. Soc. Wash., 17, July 14, 1904, p. 144.

Type locality—Dulzura, San Diego County, California.

Range—Dulzura and Twin Oaks, in San Diego County, "and thence northward at least to Morro in San Luis Obispo County" (Merriam, *supra cit.*).

Perodipus ingens Merriam

Carrizo Plain Kangaroo Rat

Original description—*Perodipus ingens* Merriam, Proc. Biol. Soc. Wash., 17, July 14, 1904, pp. 141, 142.

Type locality—Painted Rock, 20 miles southeast of Simmler, Carrizo Plain, San Luis Obispo County, California.

Synonym—Big Pocket Rat.

Range—Lower Sonoran zone on west side of southern San Joaquin Valley: vicinity of McKittrick, Kern County; Carrizo Plain, San Luis Obispo County; and Cuyama Valley, in extreme northern Santa Barbara County (Mus. Vert. Zool.).

Perodipus panamintinus Merriam

Panamint Kangaroo Rat

Original description—*Perodipus panamintinus* Merriam, Proc. Biol. Soc. Wash., **9**, June 21, 1894, p. 114.

Type locality—Head of Willow Creek, Panamint Mountains, Inyo County, California.

Synonym—Panamint Pocket Rat.

Range—Lower and Upper Sonoran zones throughout the Inyo region, and west along northern border of Mohave desert at least to Antelope Valley, northern Los Angeles County (Mus. Vert. Zool.).

Perodipus cabezonae Merriam

Cabezon Kangaroo Rat

Original description—*Perodipus cabezonae* Merriam, Proc. Biol. Soc. Wash., **17**, July 14, 1904, pp. 144, 145.

Type locality—Cabezon, Colorado Desert, Riverside County, California.

Range—Known only from the type locality, as above.

Perodipus stephensi Merriam

Stephens Kangaroo Rat

Original description—*Perodipus stephensi* Merriam, Proc. Biol. Soc. Wash., **20**, July 22, 1907, p. 78.

Type locality—San Jacinto Valley, Riverside County, California.

Range—Known only from the original description, as above.

Perodipus microps microps Merriam

Small-faced Kangaroo Rat

Original description—*Perodipus microps* Merriam, Proc. Biol. Soc. Wash., **17**, July 14, 1904, p. 145.

Type locality—Lone Pine, Owens Valley, Inyo County, California.

Synonym—Inyo Pocket Rat.

Range—Lower and Upper Sonoran zones of the Mohave desert and Inyo regions; north to near Benton, Mono County; south to Victorville, San Bernardino County (Mus. Vert. Zool.).

Perodipus microps levipes Merriam

Light-footed Kangaroo Rat

Original description—*Perodipus microps levipes* Merriam, Proc. Biol. Soc. Wash., 17, July 14, 1904, p. 145.

Type locality—Perognathus Flat, Emigrant Gap, Panamint Mountains, Inyo County, California.

Range—Known only from the original description, as above.

Dipodomys deserti deserti Stephens

Big Desert Kangaroo Rat

Original description—*Dipodomys deserti* Stephens, Amer. Nat., 21, January, 1887, pp. 42–49, pl. 5.

Type locality—Mohave River, near Hesperia, San Bernardino County, California.

Synonym—Desert Pocket Rat.

Range—Lower Sonoran zone on the Colorado and Mohave deserts; west to Carrizo Creek, western Imperial County, and to Palm Springs, Riverside County; north at least to Ballarat, Inyo County (Mus. Vert. Zool.; Elliot, Field Col. Mus., zool. ser., 3, 1904, p. 304).

Dipodomys deserti helleri Elliot

Heller Kangaroo Rat

Original description—*Dipodomys deserti helleri* Elliot, Field Col. Mus., zool. ser., 3, December, 1903, p. 249.

Type locality—Keeler, Owens Lake, Inyo County, California.

Range—Lower Sonoran zone in near vicinity of Owens Lake, Inyo County (Mus. Vert. Zool.).

Dipodomys merriami simiolus Rhoads

Allied Kangaroo Rat

Original description—*Dipodomys simiolus* Rhoads, Proc. Acad. Nat. Sci. Phila. (1893), January, 1894, pp. 410, 411.

Type locality—Agua Caliente (=Palm Springs), Riverside County, California.

Synonyms—*Dipodomys similis* Rhoads, Proc. Acad. Nat. Sci. Phila. (1893), January, 1894, p. 411 (type from White-

water, Riverside County, California); Mimic Pocket Rat; ?*Dipodomys phillipsi*, part.

Range—Lower and Upper Sonoran zones on the Colorado and Mohave deserts and the included and adjacent mountain ranges, from the Mexican line north to the Inyo region, west to the east slopes of the San Jacinto and San Bernardino mountains (Mus. Vert. Zool.).

Dipodomys merriami parvus Rhoads

San Bernardino Kangaroo Rat

Original description—*Dipodomys parvus* Rhoads, Amer. Nat., **28**, January, 1894, pp. 70, 71.

Type locality—San Bernardino, San Bernardino County, California.

Synonym—San Bernardino Pocket Rat.

Range—Lower Sonoran zone in the San Diegan district, from near the Mexican line north at least to the Cajon Wash, near San Bernardino (Mus. Vert. Zool.).

Dipodomys merriami nitratus Merriam

Keeler Kangaroo Rat

Original description—*Dipodomys merriami nitratus* Merriam, Proc. Biol. Soc. Wash., **9**, June 21, 1894, p. 112.

Type locality—Keeler, Owens Lake, Inyo County, California.

Synonym—Keeler Pocket Rat.

Range—Lower Sonoran zone in the near vicinity of Owens Lake, Inyo County (Elliot, Field Col. Mus., zool. ser., **3**, 1904, p. 302; Mus. Vert. Zool.).

Dipodomys merriami mortivallis Elliot

Death Valley Kangaroo Rat

Original description—*Dipodomys merriami mortivallis* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, pp. 250, 251.

Type locality—Furnace Creek, Death Valley, Inyo County, California.

Range—Lower Sonoran zone in Death Valley and adjacent parts of the desert floor, Inyo County (Elliot, Field Col. Mus., zool. ser., 3, 1904, p. 303).

Dipodomys merriami nevadensis Merriam

Nevada Kangaroo Rat

Original description—*Dipodomys merriami nevadensis* Merriam, Proc. Biol. Soc. Wash., **9**, June 21, 1894, pp. 111, 112.

Type locality—Pyramid Lake, Washoe County, Nevada.

Range—Lower and Upper Sonoran zones along the east-central border of the state, in Mono and Inyo counties, south into Owens Valley (Mus. Vert. Zool.).

Dipodomys merriami kernensis Merriam

Kern Valley Kangaroo Rat

Original description—*Dipodomys merriami kernensis* Merriam, Proc. Biol. Soc. Wash., **20**, July 22, 1907, pp. 77, 78.

Type locality—Onyx, Kern County, California.

Range—Lower Sonoran zone on west slope of Sierran divide in Kern Valley, Kern County: Onyx, Weldon and Kelso Creek (Mus. Vert. Zool.).

Dipodomys merriami nitratoides Merriam

Tipton Kangaroo Rat

Original description—*Dipodomys merriami nitratoides* Merriam, Proc. Biol. Soc. Wash., 9, June 21, 1894, p. 112.

Type locality—Tipton, Tulare County, California.

Synonym—Tulare Pocket Rat.

Range—Lower Sonoran zone in bed of southern San Joaquin Valley, chiefly if not altogether on the west-side alkali plains, from near Tulare Lake to Bakersfield (Mus. Vert. Zool.).

Dipodomys merriami exilis Merriam

Fresno Kangaroo Rat

Original description—*Dipodomys merriami exilis* Merriam, Proc. Biol. Soc. Wash., 9, June 21, 1894, p. 113.

Type locality—Fresno, San Joaquin Valley, California.

Synonym—Least Pocket Rat.

Range—Known only from the original description, as above.

Dipodomys californicus Merriam

California Kangaroo Rat

Original description—Dipodomys californicus Merriam, N. Amer. Fauna, **4**, October, 1890, p. 49.

Type locality—Ukiah, Mendocino County, California.

Synonyms—Dipodomys californicus pallidulus Bangs, Proc. New Eng. Zool. Club, 1, July 31, 1899, pp. 65, 66 (type from Sites, Colusa County, California); California Pocket Rat; *Dipodomys phillipii,* part.

Range—Upper Sonoran and lower Transition zones in northwestern California; south to Nicasio, Marin County, north to Scott River Valley, Siskiyou County, east to Chico, Butte County, and Vacaville, Solano County (Mus. Vert. Zool.).

Microdipodops californicus Merriam

Sierra Valley Kangaroo Mouse

Original description—Microdipodops californicus Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, p. 128.

Type locality—Sierra Valley, near Vinton, Plumas County, California.

Synonym—California Dwarf Pocket Rat.

Range—Upper Sonoran zone; known only from the type locality, as above.

Family ZAPODIDAE

Zapus major Preble

Warner Mountain Jumping Mouse

Original description—Zapus major Preble, N. Amer. Fauna, **15**, August 8, 1899, pp. 24, 25.

Type locality—Warner Mountains, Lake County, Oregon.

Range—Transition and Boreal zones in the mountains of eastern Modoc County, from Goose Lake and Sugar Hill, south to Warren Peak, Warner Mountains (Taylor, Univ. Calif. Publ. Zool., 7, 1911, p. 282; Mus. Vert. Zool.).

Zapus trinotatus trinotatus Rhoads

Northwestern Jumping Mouse

Original description—Zapus trinotatus Rhoads, Proc. Acad. Nat. Sci. Phila. (1894), January 15, 1895, pp. 421, 422.

Type locality—Lulu Island, mouth of Fraser River, British Columbia, Canada.

Range—Boreal zone in extreme northern humid coast belt: Crescent City, Del Norte County, and Carson's Camp on Mad River, Humboldt County (Preble, N. Amer. Fauna, 15, 1899, pp. 26, 27).

Zapus trinotatus alleni Elliot

Allen Jumping Mouse

Original description—*Zapus alleni* Elliot, Field Col. Mus., zool. ser., 1, March, 1898, pp. 212, 213.

Type locality—Pyramid Peak, in Eldorado County, near Lake Tahoe, California.

Range—Boreal zone on the Sierra Nevada, from Kern Peak, Tulare County, north to Mount Shasta, thence west through the Trinity Mountains, in Trinity and Siskiyou counties (Mus. Vert. Zool.).

Zapus orarius Preble

Point Reyes Jumping Mouse

Original description—*Zapus orarius* Preble, N. Amer. Fauna, 15, August 8, 1899, pp. 29, 30.

Type locality—Point Reyes, Marin County, California.

Synonym—Coast Jumping Mouse; *Zapus pacificus,* part.

Range—High Transition and Boreal zones in humid coast belt, from Point Reyes north to Humboldt Bay (Preble, *supra cit.;* Mus. Vert. Zool.).

Zapus pacificus Merriam

Pacific Jumping Mouse

Original description—*Zapus pacificus* Merriam, Proc. Biol. Soc. Wash., 11, April 26, 1897, p. 104.

Type locality—Prospect, Rogue River Valley, Jackson County, Oregon.

Range—One record: Little Shasta Creek, Siskiyou County, one specimen, "not typical" (Preble, N. Amer. Fauna, 15, 1899, pp. 30, 31; Merriam, N. Amer. Fauna, 16, 1899, p. 99).

Family ERETHIZONTIDAE

Erethizon epixanthum epixanthum Brandt

Yellow-haired Porcupine

Original description—"*Erethizon epixanthus* Brandt, Mem. Acad. St. Petersburg, 1835, p. 390, pls. 1, 9."

Type locality—"California (or Unalaska)."

Synonym—*Erethizon dorsatus epixanthus.*

Range—High Transition and Boreal zones along the Sierra Nevada, from Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 98) to the vicinity of Mount Whitney (Mus. Vert. Zool.).

Family APLODONTIIDAE

Aplodontia californica (Peters)

Sierra Mountain Beaver

Original description—*Haplodon leporinus* var. *californicus* Peters, Monats. K. Akad. Wiss. Berlin, 1864, pp. 177–179.

Type locality—The Sierra of California.

Synonym—*Aplodontia major* Merriam, Ann. New York Acad. Sci., **3**, May, 1886, p. 316 (type from Sierra Nevada, in Placer County, California); *Haplodontia rufa californica;* California Sewellel; California Mountain Beaver.

Range—High Transition and Boreal zones on the central Sierra Nevada, Mount Shasta, and the Trinity and Siskiyou mountains (Mus. Vert. Zool.; Stephens, Calif. Mammals, 1906, p. 94).

Aplodontia phaea Merriam

Point Reyes Mountain Beaver

Original description—*Aplodontia phaea* Merriam, Proc. Biol. Soc. Wash., **13**, January 31, 1899, p. 20.

Type locality—Point Reyes, Marin County, California.

Synonyms—*Haplodontia phaea;* Dark Sewellel; *?Haplodon rufus.*

Range—Transition and Boreal zones in the humid northwest coast belt, south as far as Lagunitas, Marin County (Mus. Vert. Zool.).

Family SCIURIDAE

Marmota flaviventer (Audubon and Bachman)

Yellow-bellied Marmot

Original description—*Arctomys flaviventer* Audubon and Bachman, Proc. Acad. Nat. Sci. Phila., October, 1841, pp. 99, 100.

Type locality—Mountains between Texas and California.

Synonym—Yellow-bellied Woodchuck.

Range—High Transition and Boreal zones on the Sierra Nevada from Cannell Meadow (near Kern County line), Tulare County, north at least to Nevada County (Mus. Vert. Zool.).

Citellus beecheyi douglasi (Richardson)

Douglas Ground Squirrel

Original description—*Arctomys douglasii* Richardson, Fauna Boreali-Americana, 1, 1829, p. 172.

Type locality—Banks of the Columbia River, Oregon.

Synonyms—*Citellus douglasi; Citellus variegatus douglasi; Spermophilus grammurus douglasi; Citellus grammurus douglasi.*

Range—Upper Sonoran and Transition zones throughout northern California, north from San Francisco Bay to the Oregon line; east across the upper end of the Sacramento Valley and through the Shasta and Modoc regions to the Warner Mountains. The range of *douglasi* is restricted to the west side of the Sacramento River north as far as Butte Creek, when it spreads northeast across the Valley to take in Chico and the mountain mass beyond, including Lassen Peak (Mus. Vert. Zool.; Merriam, Dept. Agric., Bur. Biol. Surv. Circ., 76, 1910, pp. 2, 3).

Citellus beecheyi beecheyi (Richardson)

California Ground Squirrel

Original description—*Arctomys beecheyi* Richardson, Fauna Boreali-Americana, 1, 1829, p. 170, pl. 12.

Type locality—Neighborhood of San Francisco and Monterey, in California.

August 26, 1913.

Synonyms—Digger Squirrel; Beechey Ground Squirrel; *Spermophilus beecheyi; Spermophilus grammurus beecheyi; Citellus variegatus beecheyi; Citellus grammurus beecheyi.*

Range—Upper Sonoran, Lower Sonoran and Transition zones of west-central California, south from San Francisco Bay throughout the coast region as far as Ventura County; also Sacramento Valley east of Sacramento River and south of Butte and Lassen counties; also northern portion of the San Joaquin Valley and west slope of middle Sierra Nevada (Mus. Vert. Zool.; Merriam, Dept. Agric., Bur. Biol. Surv. Circ., **76**, 1910, pp. 2, 3).

Citellus beecheyi fisheri (Merriam)

Fisher Ground Squirrel

Original description—*Spermophilus beecheyi fisheri* Merriam, Proc. Biol. Soc. Wash., **8**, December 28, 1893, pp. 133, 134.

Type locality—Kern Valley, 25 miles above (= east of) Kernville, Kern County, California.

Synonyms—*Spermophilus grammurus fisheri; Citellus variegatus fisheri; Citellus grammurus fisheri.*

Range—Lower Sonoran, Upper Sonoran, and Transition zones in the southern San Joaquin Valley and surrounding mountains, north at least to Madera County; east over the southern Sierra Nevada and on the desert ranges of the Inyo region as far east as the Panamint Mountains; and south through the San Diegan district and adjacent edges of the Mohave and Colorado deserts to the Mexican line (Mus. Vert. Zool.; Merriam, Dept. Agric., Bur. Biol. Surv. Circ., **76**, 1910, pp. 2, 3).

Citellus beecheyi nesioticus Elliot

Catalina Island Ground Squirrel

Original description—*Citellus nesioticus* Elliot, Field Col. Mus., zool. ser., 3, March, 1904, pp. 263, 264.

Type locality—Santa Catalina Island, Santa Barbara group, California.

Range—Santa Catalina Island (Elliot, *supra cit.*).

Citellus variegatus grammurus (Say)

Rock Squirrel

Original description—*Sciurus grammurus* Say, in Long's Exped. Rocky Mts., **2**, 1823, p. 72.

Type locality—Purgatory River, near mouth of Chacuaco Creek, Las Animas County, Colorado (*fide* Cary, N. Amer. Fauna, **33**, 1911, p. 87).

Range—Upper and Lower Sonoran zones in extreme eastern San Bernardino County: Province Mountains and canyons of the Colorado River (Merriam, Dept. Agric., Bur. Biol. Surv. Circ., **76**, 1910, p. 2).

Citellus tereticaudus tereticaudus (Baird)

Round-tailed Ground Squirrel

Original description—*Spermophilus tereticaudus* Baird, Pac. R. R. Rep., **8**, 1857, pp. 315, 316.

Type locality—Fort Yuma, Imperial County, California.

Synonym—Round-tailed Spermophile.

Range—Lower Sonoran zone on the Colorado desert, in Imperial County, west to La Puerta, eastern San Diego County; north along the valley of the Colorado River as far as Needles (Mus. Vert. Zool.).

Citellus tereticaudus chlorus Elliot

Palm Springs Ground Squirrel

Original description—*Citellus chlorus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 242.

Type locality—Palm Springs, Riverside County, California.

Synonym—Pale Spermophile.

Range—Lower Sonoran zone on the extreme west end of the Colorado Desert: Mecca northwest to Whitewater, Riverside County (Mus. Vert. Zool.).

Citellus eremonomus Elliot

Death Valley Ground Squirrel

Original description—*Citellus eremonomus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 243.

Type locality—Furnace Creek, Death Valley, Inyo County, California.

Synonym—Death Valley Spermophile.

Range—Death Valley, Inyo County (Elliot, *supra cit.*).

Citellus mohavensis (Merriam)

Mohave Ground Squirrel

Original description—*Spermophilus mohavensis* Merriam, N. Amer. Fauna, **2**, October, 1889, p. 15.

Type locality—Mohave River, above Victorville, San Bernardino County, California.

Synonyms—*Citellus tereticaudus mohavenis;* Mohave Desert Spermophile.

Range—Lower Sonoran zone on southwestern part of Mohave Desert (as above), northeast to Daggett (Elliot, Field Col. Mus., zool. ser., **3**, 1904, p. 291; Stephens, Calif. Mammals, 1906, p. 72).

Citellus mollis stephensi (Merriam)

Stephens Ground Squirrel

Original description—*Spermophilus mollis stephensi* Merriam, Proc. Biol. Soc. Wash., **12**, March 24, 1898, pp. 69, 70.

Type locality—Queen Station, near head of Owens Valley, in Esmeralda County, Nevada.

Synonym—Stephens Spermophile.

Range—Upper Sonoran zone in extreme east-central California: head of Owens Valley, Mono County (Merriam, *supra cit.;* Stephens, Calif. Mammals, 1906, p. 71).

Citellus oregonus (Merriam)

Oregon Ground Squirrel

Original description—*Spermophilus oregonus* Merriam, Proc. Biol. Soc. Wash., **12**, March 24, 1898, p. 69.

Type locality—Swan Lake Valley, Klamath Basin, Klamath County, Oregon.

Range—Upper Sonoran and Transition zones in eastern part of Modoc region: Alturas; Sugar Hill; Warner Mountains (Mus. Vert. Zool.).

Citellus beldingi (Merriam)

Belding Ground Squirrel

Original description—Spermophilus beldingi Merriam, Ann. New York Acad. Sci., **4**, December 28, 1888, pp. 317–320.

Type locality—Donner, Placer County, California.

Synonym—Belding Spermophile.

Range—Transition and Boreal zones on the central Sierra Nevada, at least from Nevada County to Eldorado County (Mus. Vert. Zool.).

Eutamias pictus (Allen)

Sage-brush Chipmunk

Original description—Tamias minimus pictus Allen, Bull. Amer. Mus. Nat. Hist., **3**, June, 1890, p. 115.

Type locality—Kelton, Boxelder County, Utah.

Synonym—Tamias pictus; Eutamias minimus pictus.

Range—Upper Sonoran zone along east base of Sierra Nevada, at least from Mono County south to latitude of Independence on both east and west sides of Owens Valley (Mus. Vert. Zool.).

Eutamias alpinus (Merriam)

Alpine Chipmunk

Original description—Tamias alpinus Merriam, Proc. Biol. Soc. Wash., **8**, December 28, 1893, pp. 137, 138.

Type locality—Big Cottonwood Meadows, 10,000 feet altitude, Sierra Nevada, Inyo County, California.

Range—Boreal zone on the southern Sierra Nevada, from Olancha Peak, Tulare County, northwards at least to Kearsarge Pass, Inyo County (Mus. Vert. Zool.).

Eutamias amoenus (Allen)

Klamath Chipmunk

Original description—Tamias amoenus Allen, Bull. Amer. Mus. Nat. Hist., **3**, June, 1890, p. 90.

Type locality—Fort Klamath, Klamath County, Oregon.

Synonyms—Tamias quadrimaculatus, part; *Tamias asiaticus quadrivittatus;* Sacramento Chipmunk, part.

Range—Transition and Boreal zones throughout northwestern California, east to the Warner Mountains, Modoc County;

west through the Trinity Mountains, Siskiyou and Trinity counties; and south along the Sierra Nevada to the vicinity of Kearsarge Pass, Inyo and Fresno counties (Merriam, Proc. Biol. Soc. Wash., **11**, 1897, pp. 190, 192; Mus. Vert. Zool.).

Eutamias panamintinus (Merriam)

Panamint Chipmunk

Original description—*Tamias panamintinus* Merriam, Proc. Biol. Soc. Wash., **8**, December 28, 1893, pp. 134, 135.

Type locality—Johnson Canyon, Panamint Mountains, Inyo County, California.

Range—Upper Sonoran and low Transition zones, on the desert ranges east of the southern Sierra Nevada; also on the east slope of the main Sierra Nevada in Inyo County, at least from Carroll Creek, northwards to Little Onion Valley (Merriam, *supra cit.*, p. 136; Mus. Vert. Zool.).

Eutamias speciosus speciosus (Allen)

San Bernardino Chipmunk

Original description—*Tamias speciosus* (Merriam, MS) Allen, Bull. Amer. Mus. Nat. Hist., **3**, June, 1890, p. 86.

Type locality—San Bernardino Mountains, California.

Range—High Transition and Boreal zones on the San Jacinto and San Bernardino mountains, and on the extreme southern Sierra Nevada from Taylor Meadow (near Kern County line), Tulare County, north at least to Kearsarge Pass, Inyo County (Merriam, Proc. Biol. Soc. Wash., **11**, 1897, pp. 191, 200; Mus. Vert. Zool.).

Eutamias speciosus frater (Allen)

Tahoe Chipmunk

Original description—*Tamias frater* Allen, Bull. Amer. Mus. Nat. Hist., **3**, June, 1890, p. 88.

Type locality—Donner, Placer County, California.

Synonyms—*Tamias quadrivittatus,* part; Sierra Nevada Chipmunk; *Eutamias frater.*

Range—Transition and Boreal zones on the Sierra Nevada in the vicinity of Summit, Placer County, and Lake Tahoe

(Merriam, Proc. Biol. Soc. Wash., **11**, 1897, pp. 192, 200), south to vicinity of Kearsarge Pass, in Inyo County (Mus. Vert. Zool.).

Eutamias speciosus inyoensis Merriam

Inyo Chipmunk

Original description—*Eutamias speciosus inyoensis* Merriam, Proc. Biol. Soc. Wash., **11**, July 1, 1897, pp. 202, 208.

Type locality—White Mountains, Inyo County, California.

Synonym—*Tamias speciosus inyoensis.*

Range—Transition and Boreal zones on the White and Inyo mountains, Inyo County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Eutamias speciosus callipeplus (Merriam)

Mount Pinos Chipmunk

Original description—*Tamias callipeplus* Merriam, Proc. Biol. Soc. Wash., **8**, December 28, 1893, p. 136.

Type locality—Summit of Mount Pinos, Ventura County, California.

Range—High Transition and Boreal zones on Mount Pinos, Ventura County, and on the western slope of the southern Sierra Nevada, from the headwaters of the Tule River northward nearly to the Yosemite Valley (Merriam, Proc. Biol. Soc. Wash., **11**, 1897, pp. 191, 200; Mus. Vert. Zool.).

Eutamias quadrimaculatus (Gray)

Long-eared Chipmunk

Original description—*Tamias quadrimaculatus* Gray, Ann. and Mag. Nat. Hist., 3rd ser., **20**, 1867, pp. 435, 436.

Type locality—Michigan Bluff, Placer County, California.

Synonyms—*Tamias macrorhabdotes* Merriam, Proc. Biol. Soc. Wash., **3**, January 27, 1886, pp. 25–28 (type from Sierra Nevada Mountains, central California, more exactly Blue Canyon, Placer County); *Eutamias macrorhabdotes.*

Range—Upper Transition zone along west slope of Sierra Nevada, from Yosemite National Park northward at least to Quincy, Plumas County (Merriam, Proc. Biol. Soc. Wash., **11**, 1897, p. 206; Mus. Vert. Zool.).

Eutamias senex (Allen)

Allen Chipmunk

Original description—Tamias senex Allen, Bull. Amer. Mus. Nat. Hist., **3**, June, 1890, p. 83.

Type locality—Summit of Donner Pass, Placer County, California.

Synonym—Gray Chipmunk.

Range—Boreal zone along the northern Sierra Nevada, south as far as Mariposa County; east to Big Valley Mountains, Lassen County, and Warner Mountains, Modoc County; west to Siskiyou and Trinity mountains (Merriam, Proc. Biol. Soc. Wash., **11**, 1897, p. 196; Mus. Vert. Zool.).

Eutamias townsendi ochrogenys Merriam

Redwood Chipmunk

Original description—Eutamias townsendi ochrogenys Merriam, Proc. Biol. Soc. Wash., **11**, July 1, 1897, pp. 195, 206, 207.

Type locality—Mendocino, Mendocino County, California.

Synonyms—Tamias townsendi; Tamias asiaticus townsendi; Tamias townsendi ochrogenys.

Range—Narrow humid northwest coast strip (Transition and Boreal zones) from the Oregon line south to Cazadero, Sonoma County; interiorly as far as Cuddeback, Humboldt County, and Sherwood, Mendocino County (Merriam, *supra cit.;* Mus. Vert. Zool.).

Eutamias hindsi (Gray)

Marin Chipmunk

Original description—Tamias hindei [= *hindsi*] Gray, Ann. and Mag. Nat. Hist., **10**, 1842, p. 264.

Type locality—Near San Francisco, California; assumed to be north of the Bay, and Nicasio, Marin County, selected as type locality (Allen, Bull. Amer. Mus. Nat. Hist., **3**, 1890, p. 77).

Synonyms—Hinds Chipmunk; Redwood Chipmunk, part; *Tamias asiaticus hindsi.*

Range—Upper Sonoran and Transition zones in Marin County, and thence north along the inner coast ranges at least to northeastern Mendocino County (Merriam, Proc. Biol. Soc. Wash., **11**, 1897, p. 197; Mus. Vert. Zool.).

Eutamias merriami pricei (Allen)

Santa Cruz Chipmunk

Original description—*Tamias pricei* Allen, Bull. Amer. Mus. Nat. Hist., **7**, December, 1895, pp. 333–335.

Type locality—Portola, San Mateo County, California.

Synonyms—*Tamias townsendi pricei; Eutamias merriami*, part; Price Chipmunk.

Range—Humid Transition and Upper Sonoran in the coast region south of San Francisco Bay, from San Mateo County to Monterey County, inclusive (Mus. Vert. Zool.).

Eutamias merriami merriami (Allen)

Merriam Chipmunk

Original description—*Tamias asiaticus merriami* Allen, Bull. Amer. Mus. Nat. Hist., **2**, October, 1889, pp. 176–178.

Type locality—San Bernardino Mountains, San Bernardino County, California.

Synonyms—*Tamias merriami; ?Tamias asiaticus quadrivittatus.*

Range—Upper Sonoran and lower Transition zones on the mountains of the San Diegan district, south to the Cuyamaca and Laguna mountains, San Diego County; also north and east through the Tehachapi mountains and along the western foothills of the Sierra Nevada at least to Raymond, Madera County; also north through the coast ranges to San Luis Obispo County (Mus. Vert. Zool.).

Callospermophilus chrysodeirus chrysodeirus (Merriam)

Sierra Golden-mantled Ground Squirrel

Original description—*Tamias chrysodeirus* Merriam, N. Amer. Fauna, **4**, October, 1890, pp. 19, 20.

Type locality—Fort Klamath, Klamath County, Oregon.

Synonyms—*Callospermophilus chrysodeirus trinitatis* Merriam, Proc. Biol. Soc. Wash., **14**, July 19, 1901, p. 126 (type

from Trinity Mountains, east of Hoopa Valley, northwestern California); *Citellus chrysodeirus;* Gilded Ground Squirrel; *Spermophilus chrysodeirus.*

Range—Upper Transition and Boreal zones of the mountains of northern California, west through the Trinity and Siskiyou mountains, east to the Warner Mountains, south along the Sierra Nevada as far as Cannell Meadow (near Kern County line), Tulare County; also on Inyo Mountains east of Owens Valley (Mus. Vert. Zool.).

Callospermophilus chrysodeirus bernardinus (Merriam)

San Bernardino Golden-mantled Ground Squirrel

Original description—*Spermophilus bernardinus* Merriam, Science, n. s., **8**, December 2, 1898, p. 782.

Type locality—San Bernardino Peak, San Bernardino County, California.

Synonyms—*Spermophilus chrysodeirus brevicaudus* Merriam, Proc. Biol. Soc. Wash., **8**, December 28, 1893, p. 134 (type from San Bernardino Peak, San Bernardino Mountains, California); *Citellus chrysodeirus bernardinus.*

Range—Upper Transition and Boreal zones on the San Bernardino Mountains (Grinnell, Univ. Calif. Publ. Zool., **5**, 1908, p. 141).

Ammospermophilus leucurus leucurus (Merriam)

Antelope Ground Squirrel

Original description—*Tamias leucurus* Merriam, N. Amer. Fauna, **2**, October, 1889, pp. 19–21.

Type locality—San Gorgonio Pass, Riverside County, California.

Synonyms—*Citellus leucurus vinnulus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 241 (type from Keeler, Inyo County, California); *Citellus leucurus; Spermophilus leucurus;* Antelope Chipmunk.

Range—Lower and Upper Sonoran zones in the southeastern desert regions, west to the east slopes of the Coast Ranges in eastern San Diego County, to San Gorgonio Pass as far as Cabezon, and to Antelope Valley, northern Los

Angeles County; north along the east side of the Sierra Nevada and through the Inyo region to Mono County (Mus. Vert. Zool.).

Ammospermophilus nelsoni (Merriam)

Nelson Ground Squirrel

Original description—Spermophilus nelsoni Merriam, Proc. Biol. Soc. Wash., **8**, December 28, 1893, pp. 129, 130.

Type locality—Tipton, Tulare County, California.

Synonyms—Citellus nelsoni; Nelson Spermophile.

Range—Lower Sonoran zone in the San Joaquin Valley, chiefly on the west side, from the vicinity of Bakersfield northeast to near Los Baños, Merced County; west to the Carrizo Plain and Cuyama Valley, San Luis Obispo County (Mus. Vert. Zool.).

Sciurus douglasi mollipilosus Audubon and Bachman

Redwood Chickaree

Original description—Sciurus molli-pilosus Audubon and Bachman, Proc. Acad. Nat. Sci. Phila., October, 1841, p. 102.

Type locality—Northern parts of California.

Synonyms—Sciurus hudsonicus orarius Bangs, Proc. Biol. Soc. Wash., **11**, December 30, 1897, pp. 281, 282 (type from Philo, Mendocino County, California); *Sciurus douglasi; Sciurus hudsonius douglassi.*

Range—Boreal and Transition zones in the northwest humid coast belt, from the Oregon line south as far as Camp Meeker, Sonoma County (Allen, Bull. Amer. Mus. Nat. Hist., **10**, 1898, p. 276; Mus. Vert. Zool.).

Sciurus douglasi albolimbatus Allen

Sierra Chickaree

Original description—Sciurus douglasii albolimbatus Allen, Bull. Amer. Mus. Nat. Hist., **10**, November 10, 1898, pp. 452, 453.

Type locality—Blue Canyon, Placer County, California.

Synonyms—Sciurus hudsonius californicus Allen, Bull. Amer. Mus. Nat. Hist., **3**, November, 1890, pp. 165, 166 (type from Blue Canyon, Placer County, California).

Range—Boreal zone along the entire Sierra Nevada from Taylor Meadow (near Kern County line), Tulare County, north to the Oregon line; east to the Warner Mountains, Modoc County; and west through the Siskiyou and Trinity mountains (Allen, Bull. Amer. Mus. Nat. Hist., **10**, 1898, p. 280; Mus. Vert. Zool.).

Sciurus griseus griseus Ord

California Gray Squirrel

Original description—"*Sciurus griseus* Ord, Journ. de Phys., **87**, 1818, p. 152."

Type locality—"The Dalles, Columbia River, Wasco County, Oregon."

Synonyms—*Sciurus heermanni* Le Conte, Proc. Acad. Nat. Sci. Phila., 1852, p. 149 (type from California, probably near Fort Tejon); *Sciurus fossor,* part; *Sciurus griseus nigripes,* part; *Sciurus leporinus.*

Range—Transition and high Upper Sonoran zones throughout the Sierra Nevada region, from Greenhorn Mountains, Kern County, north to the Oregon line, thence south coastwise, chiefly east of the redwood belt, to Marin County (Mus. Vert. Zool.).

Sciurus griseus nigripes Bryant

Black-footed Gray Squirrel

Original description—*Sciurus fossor nigripes* Bryant, Proc. Cal. Acad. Sci., June 20, 1889, pp. 25, 26.

Type locality—San Mateo County, California.

Synonym—*Sciurus fossor,* part.

Range—Humid coast Transition south of San Francisco Bay, from San Mateo County to Monterey County, inclusive (Mus. Vert. Zool.).

Sciurus griseus anthonyi Mearns

Anthony Gray Squirrel

Original description—*Sciurus fossor anthonyi* Mearns, Proc. U. S. Nat. Mus., **20**, 1898, pp. 501, 502.

Type locality—Campbell's ranch, Laguna Mountains, eastern San Diego County, California.

Synonym—*Sciurus fossor nigripes,* part.

Range—Transition zone of southern California, from near the Mexican boundary northwest to the mountains of Ventura County (Mus. Vert. Zool.).

Family PETAURISTIDAE

Sciuropterus alpinus stephensi Merriam

Mendocino Flying Squirrel

Original description—*Sciuropterus oregonensis stephensi* Merriam, Proc. Biol. Soc. Wash., **13**, June 13, 1900, p. 151.

Type locality—Sherwood, Mendocino County, California.

Synonyms—California Coast Flying Squirrel; Stephens Flying Squirrel.

Range—Transition zone in northwest humid coast belt; but one precise locality so far known, as above.

Sciuropterus alpinus klamathensis Merriam

Klamath Flying Squirrel

Original description—*Sciuropterus alpinus klamathensis* Merriam, Proc. Biol. Soc. Wash., **11**, July 15, 1897, p. 225.

Type locality—Transition zone, altitude 4200 feet, Fort Klamath, Klamath County, Oregon.

Synonym—*Sciuropterus volucella hudsonius.*

Range—Transition and Boreal zones of the interior of northern California: Warner Mountains, Modoc County, and Trinity Mountains, in Siskiyou and Trinity counties (Mus. Vert. Zool.); Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 92).

Sciuropterus alpinus lascivus Bangs

Sierra Nevada Flying Squirrel

Original description—*Sciuropterus alpinus lascivus* Bangs, Proc. New Eng. Zool. Club, **1**, July 31, 1899, p. 69.

Type locality—Tallac, Eldorado County, California.

Range—Transition zone on central Sierra Nevada.

Sciuropterus alpinus californicus Rhoads

San Bernardino Flying Squirrel

Original description—*Sciuropterus alpinus californicus* Rhoads, Proc. Acad. Nat. Sci. Phila., June, 1897, pp. 323, 324.

Type locality—San Bernardino Mountains, San Bernardino County, California.

Synonyms—*Sciuropterus californicus;* California Flying Squirrel.

Range—Transition zone on the San Bernardino and San Jacinto mountains (Rhoads, *supra cit.;* Grinnell, Univ. Calif. Publ. Zool., **5**, 1908, p. 138; Mus. Vert. Zool.).

Family CASTORIDAE

Castor subauratus Taylor

Golden Beaver

Original description—*Castor subauratus* Taylor, Univ. Calif. Publ. Zool., **10**, May 21, 1912, p. 167.

Synonyms—*Castor canadensis pacificus; Castor canadensis*, part.

Type locality—San Joaquin River at Grayson, Stanislaus County, California.

Range—Larger streams of Sacramento and San Joaquin basins, at least from Shasta County south to Stanislaus County.

Castor canadensis frondator Mearns

Sonora Beaver

Original description—*Castor canadensis frondator* Mearns, Proc. U. S. Nat. Mus., **20**, March 5, 1897, pp. 502, 503.

Type locality—San Pedro River, near Mexican boundary, Sonora, Mexico.

Synonym—*Castor canadensis*, part.

Range—Along the Colorado River from the Nevada line to the Mexican line.

Order LAGOMORPHA

Family OCHOTONIDAE

Ochotona schisticeps (Merriam)

Gray-headed Cony

Original description—*Lagomys schisticeps* Merriam, N. Amer. Fauna, **2**, October 30, 1889, p. 11.

Type locality—Donner, Placer County, California.

Synonym—Lagomys schisticeps, part; Gray-headed Pika; *Lagomys princeps.*

Range—Boreal zone of central Sierra Nevada, at least from Summit, Placer County, south to Heather Lake, Eldorado County (Mus. Vert. Zool.); Mount Shasta (Merriam, N. Amer. Fauna, **16**, 1899, p. 99).

Ochotona taylori Grinnell

Warner Mountain Cony

Original description—Ochotona taylori Grinnell, Proc. Biol. Soc. Wash., **25**, July 31, 1912, pp. 129, 130.

Type locality—Warren Peak, 9000 feet altitude, Warner Mountains, Modoc County, California.

Range—Boreal zone on the Warner Mountains, including Sugar Hill, Modoc County (Grinnell, *supra cit.*).

Ochotona albatus Grinnell

Mount Whitney Cony

Original description—Ochotona albatus Grinnell, Univ. Calif. Publ. Zool., **10**, January 31, 1912, p. 125.

Type locality—Cottonwood Lakes, 11,000 feet, Sierra Nevada, Inyo County, California.

Synonym—Ochotona schisticeps, part.

Range—Close to timberline in Boreal zone of southern Sierra Nevada, in Inyo and Tulare counties, at least from Kearsarge Pass south to Cottonwood Pass (Mus. Vert. Zool.).

Family LEPORIDAE

Lepus campestris townsendi Bachman

Western White-tailed Jack Rabbit

Original description—Lepus townsendi Bachman, Journ. Acad. Nat. Sci. Phila., **8**, pt. 1, 1839, pp. 90–94, pl. 2.

Type locality—Fort Walla Walla, Washington.

Synonym—Lepus campestris.

Range—Of sparse distribution in the Upper Sonoran and Transition zones of the Modoc region of northeastern California: Fort Crook, Shasta County, and Goose Lake, Modoc County (Nelson, N. Amer. Fauna, **29**, 1909, p. 82); and Parker Creek, Warner Mountains (Mus. Vert. Zool.).

Lepus campestris sierrae Merriam

Sierra White-tailed Jack Rabbit

Original description—*Lepus campestris sierrae* Merriam, Proc. Biol. Soc. Wash., **17**, July 14, 1904, p. 132.

Type locality—Hope Valley, altitude 7800 feet, Alpine County, California.

Range—Boreal zone on the Sierra Nevada from vicinity of Lake Tahoe (Merriam, *supra cit.*) south to Monache Meadows, Tulare County (Mus. Vert. Zool.); also, probably, on Mount Shasta (Nelson, N. Amer. Fauna, **29**, 1909, p. 84).

Lepus washingtoni klamathensis Merriam

Oregon Snowshoe Rabbit

Original description—*Lepus klamathensis* Merriam, N. Amer. Fauna, **16**, October, 1899, p. 100.

Type locality—Fort Klamath, Oregon.

Synonym—Klamath Rabbit.

Range—Boreal zone on the central Sierra Nevada, at least from Donner, Placer County, to Pacific, Eldorado County (Nelson, N. Amer. Fauna, **29**, 1909, pp. 107, 109); also Trinity Mountains, Trinity County (Mus. Vert. Zool.).

Lepus californicus californicus Gray

California Jack Rabbit

Original description—*Lepus californica* Gray, Mag. Nat. Hist. (Charlesworth), **1**, 1837, p. 586.

Type locality—St. Antoine, California, that is, Mission of San Antonio, Jolon, Monterey County (*fide* Nelson, N. Amer. Fauna, **29**, 1909, p. 129).

Synonym—*Lepus longicaudatus.*

Range—Upper Sonoran zone of west-central and northern California, from northern Santa Barbara County to the Oregon line, interiorly to include Shasta Valley and the whole of Sacramento Valley and adjacent foothills (Nelson, *supra cit.*, p. 132; Mus. Vert. Zool.).

Lepus californicus wallawalla Merriam

Washington Jack Rabbit

Original description—*Lepus texianus wallawalla* Merriam, Proc. Biol. Soc. Wash., **17**, July 14, 1904, p. 137.

Type locality—Touchet, Plains of Columbia, Washington.

Range—Upper Sonoran and lower Transition zones in the Modoc region of northwestern California, west to Beswick, Siskiyou County, and south to Beckwith, Plumas County (Nelson, N. Amer. Fauna, **29**, 1909, p. 133; Mus. Vert. Zool.).

Lepus californicus richardsoni Bachman

San Joaquin Jack Rabbit

Original description—*Lepus richardsonii* Bachman, Journ. Acad. Nat. Sci. Phila., **8**, pt. 1, 1839, pp. 88–90.

Type locality—Not known exactly, but probably near Jolon, Monterey County, California (see Merriam, Proc. Biol. Soc. Wash., **17**, 1904, p. 136).

Synonyms—*Lepus tularensis* Merriam, *supra cit.*, pp. 136, 137 (type from Alila [=Earlimart], Tulare County, California); *Lepus californicus*, part.

Range—Lower Sonoran and low Upper Sonoran zones in the San Joaquin Valley, surrounding foothills, and valleys to the westward to and including Salinas and Cuyama valleys (Nelson, N. Amer. Fauna, **29**, 1909, p. 136; Mus. Vert. Zool.).

Lepus californicus bennetti Gray

San Diego Jack Rabbit

Original description—"*Lepus bennetti* Gray, Zool. Voyage Sulphur, 1844, p. 35, pl. 14."

Type locality—"San Diego, California."

Synonym—*Lepus californicus*, part.

Range—Lower and Upper Sonoran zones in the San Diegan district, from the Mexican line northwest to southern Santa Barbara County, altogether west of the desert divides (Nelson, N. Amer. Fauna, **29**, 1909, p. 137; Mus. Vert. Zool.).

Lepus californicus deserticola Mearns

Colorado Desert Jack Rabbit

Original description—*Lepus texianus deserticola* Mearns, Proc. U. S. Nat. Mus., **18**, June 24, 1896, p. 564.

Type locality—Western edge of Colorado Desert, at east base of Coast Range, in San Diego County, California.

Synonym—*Lepus californicus*, part.

August 26, 1913.

Range—Chiefly Lower Sonoran zone (locally up through Transition) in the desert regions of southeastern California, west to the eastern confines of the San Diegan district, and north, east of the Sierra Nevada, to Mono Lake (Nelson, N. Amer. Fauna, **29**, 1909, pp. 137, 140; Mus. Vert. Zool.).

Sylvilagus nuttalli nuttalli (Bachman)

Washington Cottontail

Original description—*Lepus nuttallii* Bachman, Journ. Acad. Nat. Sci. Phila., **7**, pt. 2, 1837, pp. 345–348, pl. 22, fig. 1.

Type locality—Probably eastern Oregon near mouth of Malheur River (see Nelson, N. Amer. Fauna, **29**, 1909, p. 201).

Range—Upper Sonoran and Transition zones in parts of the Modoc region of northeastern California, west to Shasta Valley, Siskiyou County, and south to Mono Lake, Mono County (Nelson, *supra cit.*, pp. 201, 204; Mus. Vert. Zool.).

Sylvilagus nuttalli grangeri (Allen)

Black Hills Cottontail

Original description—*Lepus sylvaticus grangeri* Allen, Bull. Mus. Nat. Hist., **7**, August 21, 1895, pp. 264, 265.

Type locality—Hill City, Black Hills, Custer County, South Dakota.

Synonym—*Lepus laticinctus perplicatus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 255 (type from Hannopee Canyon, Panamint Mountains, Inyo County, California.

Range—High Upper Sonoran and Transition zones on desert ranges of the Inyo region, from White Mountains south to the Coso and Panamint mountains (Nelson, N. Amer. Fauna, **29**, 1909, pp. 204, 207).

Sylvilagus auduboni auduboni (Baird)

Sacramento Cottontail

Original description—*Lepus audubonii* Baird, Pac. R. R. Rep., **8**, 1857, pp. 608–610, pl. 58, fig. 2.

Type locality—San Francisco, California.

Synonym—*Lepus sylvaticus auduboni.*

Range—Upper Sonoran zone in Sacramento Valley and San Francisco Bay region; recorded north to Red Bluff, Tehama County, and South to Los Baños, Merced County (Nelson, N. Amer. Fauna, **29**, 1909, pp. 214, 216; Mus. Vert. Zool.); not reported from the coast belt north of San Francisco Bay nor south of the Santa Clara Valley.

Sylvilagus auduboni vallicola Nelson

San Joaquin Cottontail

Original description—*Sylvilagus auduboni vallicola* Nelson, Proc. Biol. Soc. Wash., **20**, July 22, 1907, pp. 82, 83.

Type locality—San Emigdio Ranch (25 miles southwest of Bakersfield), Kern County, California.

Range—Lower Sonoran zone (locally into Upper Sonoran) in the southern San Joaquin Valley, west to the Cuyama and Salinas valleys; recorded north to Raymond, Madera County, and south to the Walker and Tejon passes (Nelson, N. Amer. Fauna, **29**, 1909, pp. 216, 218; Mus. Vert. Zool.).

Sylvilagus auduboni sanctidiegi (Miller)

San Diego Cottontail

Original description—*Lepus floridanus sanctidiegi* Miller, Proc. Acad. Nat. Sci. Phila., October, 1899, pp. 389, 390.

Type locality—Mexican boundary near Pacific Ocean, in San Diego County, California.

Range—Upper and Lower Sonoran zones in the San Diegan district, west of the desert divides, from southern Ventura County southwest to the Mexican line (Nelson, N. Amer. Fauna, **29**, 1909, pp. 218, 220; Mus. Vert. Zool.).

Sylvilagus auduboni arizonae (Allen)

Arizona Cottontail

Original description—*Lepus sylvaticus* var. *arizonae* Allen, Mon. N. Amer. Rodentia, 1877, p. 332.

Type locality—Beal Spring, 2 miles from Kingman, Mohave County, Arizona.

Synonyms—*Lepus laticinctus* Elliot, Field Col. Mus., zool. ser., **3**, December, 1903, p. 254 (type from Oro Grande, Mohave Desert, San Bernardino County, California); *Lepus*

laticinctus rufipes Elliot, *supra cit.*, pp. 254, 255 (type from Furnace Creek, Death Valley, Inyo County, California).

Range—Lower Sonoran and, locally, Upper Sonoran zone of the Colorado and Mohave desert regions; west to eastern border of the San Diegan district; north, east of the Sierra Nevada, through Owens Valley (Nelson, N. Amer. Fauna, **29**, 1909, pp. 222, 225; Mus. Vert. Zool.).

Sylvilagus bachmani bachmani (Waterhouse)

California Brush Rabbit

Original description—*Lepus bachmani* Waterhouse, Proc. Zool. Soc. London, 1838, pp. 103–105.

Type locality—California, probably between Monterey and Santa Barbara, later fixed at San Luis Obispo (see Nelson, N. Amer. Fauna, **29**, 1909, p. 247).

Synonym—*Lepus trowbridgii* Baird, Proc. Acad. Nat. Sci. Phila., April, 1855, p. 333 (type from Monterey, California).

Range—Upper Sonoran zone in the narrow coastal belt from Santa Monica, Los Angeles County, northwest to Monterey, thence north to Mount Hamilton and along western side of Santa Clara Valley to Black Mountain; also western foothills of Sierra Nevada from Tulare County to Shasta County (Nelson, *supra cit.*, pp. 247, 250; Mus. Vert. Zool.).

Sylvilagus bachmani ubericolor (Miller)

Redwood Brush Rabbit

Original description—*Lepus bachmani ubericolor* Miller, Proc. Acad. Nat. Sci. Phila., October, 1899, pp. 383, 384.

Type locality—Beaverton, Washington County, Oregon.

Synonyms—*Lepus trowbridgei*, part; *Lepus bachmani*, part; *Lepus floridanus ubericolor*.

Range—Transition and high Upper Sonoran zones in humid coast belt, from vicinity of Santa Cruz north to the Oregon line, including most of the San Francisco Bay region; also interiorly, at the north, to the head of the Sacramento Valley (Nelson, N. Amer. Fauna, **29**, 1909, pp. 250, 252; Mus. Vert. Zool.).

Sylvilagus bachmani cinerascens (Allen)

Ashy Brush Rabbit

Original description—*Lepus cinerascens* Allen, Bull. Amer. Mus. Nat. Hist., **3**, October, 1890, p. 159.

Type locality—San Fernando, Los Angeles County, California.

Range—Upper Sonoran zone in the San Diegan district, from the Mexican line northwest through the interior of Ventura and Santa Barbara counties; thence north through the inner coast ranges west of the San Joaquin Valley to Jolon and Jamesburg on west side of Salinas Valley, in Monterey County; and east around southern rim of San Joaquin Valley to vicinity of Walker Pass (Nelson, N. Amer. Fauna, **29**, 1909, pp. 252, 253; Mus. Vert. Zool.).

Brachylagus idahoensis (Merriam)

Idaho Pigmy Rabbit

Original description—*Lepus idahoensis* Merriam, N. Amer. Fauna, **5**, July, 1891, pp. 76, 77.

Type locality—Pahsimeroi Valley, Custer County, Idaho.

Range—Upper Sonoran zone in extreme eastern part of the Modoc region, northeastern California; the only record station to date is Goose Lake, Modoc County (Nelson, N. Amer. Fauna, **29**, 1909, pp. 275, 278).

Order ARTIODACTYLA

Family CERVIDAE

Cervus roosevelti Merriam

Roosevelt Elk

Original description—*Cervus roosevelti* Merriam, Proc. Biol. Soc. Wash., **11**, December 17, 1897, pp. 272, 273.

Type locality—Mount Elaine, near Mount Olympus, Olympic Mountains, Washington.

Synonyms—*Cervus canadensis*, part; *Cervus canadensis occidentalis;* Roosevelt Wapiti.

Range—Northwest humid coast belt chiefly in the Transition zone, south formerly to Marin County (Mailliard, MS), east

at least to the vicinity of Mount Shasta (Townsend, Proc. U. S. Nat. Mus., **10**, 1887, p. 168); now existing in relatively small numbers in Del Norte and Humboldt counties (according to information received through California Fish and Game Commission).

Cervus nannodes Merriam

Dwarf Elk

Original description—*Cervus nannodes* Merriam, Proc. Biol. Soc. Wash., **18**, February 2, 1905, pp. 24, 25.

Type locality—Buttonwillow, Kern County, California.

Synonym—*Cervus canadensis*, part; California Wapiti; San Joaquin Valley Elk; Tule Elk.

Range—Lower Sonoran zone, formerly in the San Joaquin Valley, especially in its southern part, west through the coast ranges to the Cuyama Valley in northern Santa Barbara County, and to Santa Clara Valley in Santa Clara County (Rowley, MS; Mus. Vert. Zool.); also probably north through the Sacramento Valley at least as far as the vicinity of Marysville Buttes. Now only in western Kern County, between Tulare and Buena Vista lakes and adjacent hills to the west; a transplanted herd in the Sequoia National Park, Tulare County.

Odocoileus virginianus macrourus (Rafinesque)

White-tailed Deer

Original description—*Corvus (=Cervus) macrourus* Rafinesque, Amer. Monthly Mag., **1**, October, 1817, p. 436.

Type locality—Plains of Kansas River, Upper Missouri Valley.

Synonym—*Odocoileus americanus macrourus.*

Range—Said to have formerly occurred in extreme eastern and northeastern California, chiefly in the Modoc region. Many accounts by hunters, but no verified or recent report.

Odocoileus columbianus columbianus (Richardson)

Columbian Black-tailed Deer

Original description—*Cervus macrotis* var. *columbiana* Richardson, Fauna Boreali-Americana, **1**, 1829, p. 257.

Type locality—Mouth of the Columbia River, Oregon or Washington.

Synonym—*?Cervus lewisii* Peale, U. S. Exploring Exped., **8**, 1848, "p. 39, pl. 9" (type from Feather River, Upper California).

Range—Northwest coast region chiefly in the Transition and Boreal zones; east throughout the inner coast ranges to the Sacramento Valley, and at the north to and including Mount Shasta and near vicinity; south to the north side of San Francisco Bay.

Odocoileus columbianus scaphiotus Merriam

Southern Black-tailed Deer

Original description—*Odocoileus columbianus scaphiotus* Merriam, Proc. Biol. Soc. Wash., **12**, April 30, 1898, p. 101.

Type locality—Laguna Ranch, Gabilan Range, San Benito County, California.

Synonyms—*Odocoileus columbianus*, part; Columbian Black-tailed Deer, part.

Range—Transition and high Upper Sonoran zones south from San Francisco Bay through the Santa Cruz district at least into Monterey and San Benito counties. In spite of expressed doubts as to the existence of two recognizable forms of the black-tailed deer within the state, material accumulated in the collection of the California Academy of Sciences affords basis for the belief that two races do exist (*columbianus* and *scaphiotus*), with ranges as here defined (Rowley, MS).

Odocoileus hemionus hemionus (Rafinesque)

Rocky Mountain Mule Deer

Original description—*Cervus hemionus* Rafinesque, Amer. Monthly Mag., **1**, October, 1817, p. 436.

Type locality—Sioux River, South Dakota.

Range—Eastern California, including main Sierra Nevada south into Kern County and north to vicinity of Mount Lassen, thence northeast through the Modoc region. Western limit at extreme north, Mount Shasta (Rowley, MS). Not in the desert ranges east of Owens Valley except in winter. Occurs in summer on the high Sierras up to timberline; in winter most numerous in the foothills.

Odocoileus hemionus californicus (Caton)

California Mule Deer

Original description—*Cervus macrotis* var. *californicus* Caton, Amer. Nat., **10**, August, 1876, p. 464.

Type locality—Near Gaviota Pass, 40 miles westward from Santa Barbara, in Santa Barbara County, California.

Range—Upper Sonoran and Transition zones of southern California west of the desert proper, from the Mexican line northwest through the San Diegan district at least to San Luis Obispo County, and east through the Tejon region to the Tehachapi Mountains.

Odocoileus hemionus eremicus (Mearns)

Burro Deer

Original description—*Dorcelaphus hemionus eremicus* Mearns, Proc. U. S. Nat. Mus., **20**, February 11, 1897, pp. 470, 471.

Type locality—Sierra Seri, Sonora, Mexico, near Gulf of California.

Synonym—Desert Mule Deer.

Range—Lower Sonoran zone on the Colorado desert, formerly north along the Colorado River at least to the vicinity of Palo Verde, and northwest around Salton Sea; now rare or entirely wanting north of the Mexican line.

Family ANTILOCAPRIDAE

Antilocapra americana americana (Ord)

Prong-horn Antelope

Original description—"*Antelope americana* Ord, Guthrie's Geo., 2nd Amer. ed., 2, 1815, pp. 292, 308."

Type locality—On the plains and highlands of the Missouri (*fide* Miller and Rehn, Proc. Boston Soc. Nat. Hist., **30**, **1901**, p. 20).

Range—Formerly nearly throughout the state south and east of the humid coast-belt and below the Boreal zone; chiefly, however, on the interior plains and valleys both east and west of the desert divides. Now only isolated bands exist: in the Modoc region, in the southern San Joaquin Valley on the west

side, on the western arm of the Mohave desert in northern Los Angeles County or southern Kern County, and on the Colorado desert near the Mexican line, in eastern San Diego County or western Imperial County.

Family BOVIDAE

Ovis canadensis nelsoni Merriam

Desert Bighorn

Original description—*Ovis nelsoni* Merriam, Proc. Biol. Soc. Wash., **11**, July 15, 1897, pp. 217, 218.

Type locality—Grapevine Mountains, on boundary between California and Nevada, just south of latitude 37°.

Synonyms—*Ovis canadensis,* part; *Ovis cervina nelsoni;* Mountain Sheep, part; Desert Sheep.

Range—Lower and Upper Sonoran zones on the Mohave and Colorado deserts and adjacent and included ranges, west to the Santa Rosa Mountains, Riverside County, northwest (formerly) through the Tejon region to the Caliente Hills, San Luis Obispo County, and north through the Inyo region east of Owens Valley.

Ovis canadensis sierrae Grinnell

Sierra Nevada Bighorn

Original description—*Ovis cervina sierrae* Grinnell, Univ. Calif. Publ. Zool., **10**, May 9, 1912, pp. 144–150.

Type locality—East slope Mount Baxter, 11,000 feet altitude, Sierra Nevada, Inyo County, California.

Synonyms—*Ovis canadensis,* part; Mountain Sheep, part.

Range—High Sierra Nevada, formerly at least from Mariposa County to Tulare County; also (probably this race) in the vicinity of Mount Shasta east to the Warner Mountains, Modoc County. Now only from Mono County south to the vicinity of Mount Whitney; restricted to Boreal zone in summer, descending in winter to east base of the Sierra Nevada. There are sheep still existing on the San Gabriel Mountains (Transition zone), southern California; status unknown.

Order CETACEA

Family DELPHINIDAE

Tursiops gilli Dall

Cowfish

Original description—*Tursiops gillii* Dall, Proc. Cal. Acad. Sci., **5**, April, 1873, p. 13.

Type locality—Monterey, California (*fide* True, Bull. U. S. Nat. Mus., **36**, 1889, p. 43).

Range—The ocean and bays coastwise (Scammon, Marine Mammals, 1874, p. 101).

Delphinus delphis Linnaeus

Common Dolphin

Original description—*Delphinus delphis* Linnaeus, Syst. Nat., **1**, 1758, p. 77.

Type locality—North Atlantic Ocean near Europe.

Synonym—*Delphinus bairdii* Dall, Proc. Cal. Acad. Sci., **5**, April, 1873, pp. 12, 13 (types from Point Arguello, Santa Barbara County, California); Baird Dolphin.

Range—The ocean and bays coastwise (Scammon, Marine Mammals, 1874, p. 99; True, Bull. U. S. Nat. Mus., **36**, **1889**, p. 52).

Lissodelphis borealis (Peale)

Northern Right Whale Porpoise

Original description—*Delphinapterus borealis* Peale, U. S. Explor. Exped., **8**, 1848, p. 35, "pl. 8, fig. 2."

Type locality—North Pacific Ocean, lat 46° 6′ 50″, long. 134° 5′ W.

Synonyms—*Leucorhamphus borealis; Tursio borealis.*

Range—The ocean coastwise from San Diego Bay northwards (Scammon, Marine Mammals, 1874, p. 101).

Lagenorhynchus obliquidens Gill

Striped Porpoise

Original description—*Lagenorhynchus obliquidens* Gill, Proc. Acad. Nat. Sci. Phila., September, 1865, pp. 177, 178.

Type locality—San Francisco, California.

Synonym—Common Porpoise, part.

Range—The ocean coastwise (Scammon, Marine Mammals, 1874, p. 98).

Phocaena phocaena (Linnaeus)

Bay Porpoise

Original description—*Delphinus phocaena* Linnaeus, Syst. Nat., 1, 1758, p. 77.

Type locality—European and Baltic seas.

Synonyms—*Phocaena communis; Phocaena vomerina;* Common Porpoise, part.

Range—The ocean and bays coastwise including San Francisco Bay (Scammon, Marine Mammals, 1874, pp. 95, 97).

Grampus griseus (Cuvier)

Common Grampus

Original description—"*Delphinus griseus* Cuvier, Ann. Mus. Paris, 1812, p. 14, pl. 1, fig. 1."

Type locality—"Brest, coast of France."

Synonym—*Grampus stearnsii* Dall, Proc. Calif. Acad. Sci., 5, January, 1873, p. 13 (types from Monterey, California).

Range—The ocean coastwise (Scammon, Marine Mammals, 1874, pp. 103, 300).

Globicephalus scammoni Cope

Scammon Blackfish

Original description—*Globiocephalus scammoni* Cope, Proc. Acad. Nat. Sci. Phila., 1869, p. 21.

Type locality—Coast of Lower California (*fide* Dall, *in* Scammon, Marine Mammals, 1874, p. 299).

Range—The ocean north from Lower California (Scammon, Marine Mammals, 1874, pp. 85–87).

Orcinus ater (Cope)

Pacific Killer

Original description—*Orca ater* Cope, Proc. Acad. Nat. Sci. Phila., 1869, p. 22.

Type locality—Northwest coast.

Synonyms—*Orcinus orca; Orcinus rectipinna,* part; Black Killer; Orca.

Range—In the ocean coastwise (Scammon, Marine Mammals, 1874, p. 90).

Orcinus rectipinna (Cope)

Straight-finned Killer

Original description—*Orca rectipinna* Cope, Proc. Acad. Nat. Sci. Phila., 1869, p. 22.

Type locality—California.

Range—In the ocean coastwise, especially to the northward (Scammon, Proc. Acad. Nat. Sci. Phila., 1869, pp. 56, 57).

Family ZIPHIIDAE

Berardius bairdi Stejneger

Baird Beaked Whale

Original description—*Berardius bairdii* Stejneger, Proc. U. S. Nat. Mus., **6**, 1883, pp. 75, 76.

Type locality—Stare Gavan, Bering Island, Bering Sea.

Synonym—Baird Sperm Whale.

Range—Ocean along northwest coast: Centerville Beach near Ferndale, and Trinidad, Humboldt County (True, Bull. U. S. Nat. Mus., **73**, 1910, pp. 2, 63).

Family PHYSETERIDAE

Physeter macrocephalus Linnaeus

Sperm Whale

Original description—*Physeter macrocephalus* Linnaeus, Syst. Nat., **1**, 1758, p. 76.

Type locality—North Atlantic Ocean near Europe.

Range—Formerly in the ocean north along the coast of California (Scammon, Proc. Acad. Nat. Sci. Phila., 1869, p. 61).

Family BALAENIDAE

Balaena sieboldi Gray

Pacific Right Whale

Original description—*Balaena sieboldii* Gray, Ann. and Mag. Nat. Hist., 3rd ser., 14, 1864, p. 349.

Type locality—Coast of Japan.

Synonym—Siebold Baleen Whale; *Balaena japonica; Balaena cullamach.*

Range—Few along coast of California (Scammon, Marine Mammals, 1874, p. 66).

Rhachianectes glaucus (Cope)

California Gray Whale

Original description—*Agaphelus glaucus* Cope, Proc. Acad. Nat. Sci. Phila., June, 1868, pp. 159, 160.

Type locality—Coast of California: Monterey (see Dall, *in* Scammon, Marine Mammals, 1874, p. 301).

Synonym—Gray Baleen Whale.

Range—Frequent in the ocean and bays coastwise from November to May (Scammon, Marine Mammals, 1874, pp. 22, 23).

Megaptera versabilis Cope

Pacific Humpback Whale

Original description—*Megaptera versabilis* Cope, Proc. Acad. Nat. Sci. Phila., 1869, pp. 15, 16.

Type locality—North Pacific.

Synonym—*Megaptera nodosa versabilis.*

Range—In the ocean and bays coastwise; Monterey Bay, April to December (Scammon, Marine Mammals, 1874, p. 44).

Balaenoptera velifera Cope

Pacific Finback Whale

Original description—*Balaenoptera velifera* Cope, Proc. Acad. Nat. Sci. Phila., 1868, p. 16.

Type locality—Coast of Oregon.

Synonyms—*Balaenoptera physalis velifera;* Oregon Finback Whale.

Range—In the ocean and bays coastwise (Scammon, Marine Mammals, 1874, pp. 34–36).

Balaenoptera sulfureus (Cope)

Pacific Sulphur-bottom Whale

Original description—*Sibbaldius sulfureus* Cope, Proc. Acad. Nat. Sci. Phila., 1869, p. 20.

Type locality—Northwest Coast.

Range—At all seasons along the coast of California (Scammon, Marine Mammals, 1874, p. 71).

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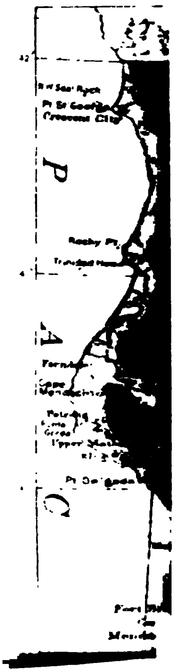
EXPLANATION OF PLATE XV

Map showing the Life Zones of California.


42
Crescent City
P
Rocky Pt.
A
Cape
C

EXPLANATION OF PLATE XVI

Map showing Faunal Districts of California.


FAUNAL DISTRICTS OF CALIFORNIA
1. Modoc (Great Basin)
2. Trinity Mountain
3. Sierra Nevada
4. Sierra Foothill
5. Northern Humid Coast (Humboldt Bay + Marin)
6. Santa Cruz (Humid Coast)
7. San Francisco Bay
8. Sacramento Valley
9. Clear Lake
10. San Joaquin
11. San Diego
12. San Bernardino Mountain
13. Santa Barbara Islands
14. Inyo
15. Mohave Desert
16. Colorado Desert
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A LIST OF THE AMPHIBIANS AND REPTILES OF ARIZONA, WITH NOTES ON THE SPECIES IN THE COLLECTION OF THE ACADEMY

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Early in March, 1912, the authors of this paper arrived in Yuma and began the gathering of a representative collection of Arizonan reptiles and amphibians. March and the first week of April were spent there and in the vicinity of Tucson, where large collections were secured. The senior author then returned to San Francisco, leaving Mr. Slevin to continue the work in various parts of Arizona throughout the summer. Mr. John I. Carlson, in 1910, had made considerable collections in Yuma and Maricopa counties under my direction. Our thanks are particularly due to the late Mr. Herbert Brown of Tucson, who is well known as a student of the natural history of Arizona, for his kind aid, gifts of specimens, and advice as to favorable collecting grounds. Professor Brown, of the University of Arizona, and Mr. Bancroft very kindly gave us a number of specimens. The authorities of the Carnegie Desert Laboratory at Tucson also were most generous in their assistance, with gifts of specimens and the loan of camping equipment which made possible the trip to the summit of Mt. Lemon.

The Arizonan collections at hand number about three thousand specimens, and include a large majority of the species known from the state. Some species have been credited to

Arizona without sufficient evidence of their occurrence there. The following list is thought to include all species now known to live in Arizona. Those which the Academy has not yet secured from within the borders of that state are indicated by a star preceding the number. Following this list are given notes on the species represented in our collections.

List of the Amphibians and Reptiles of Arizona

* 1. Ambystoma tigrinum
2. Hyla arenicolor
3. Bufo lentiginosus woodhousii
4. Bufo punctatus
5. Bufo alvarius
6. Bufo cognatus
7. Scaphiopus couchii
* 8. Scaphiopus hammondii
9. Rana pipiens
10. Kinosternon sonoriense
11. Terepene ornata
12. Gopherus agassizii
13. Coleonyx variegatus
14. Dipsosaurus dorsalis
15. Sauromalus ater
16. Crotaphytus collaris baileyi
17. Crotaphytus wislizenii
18. Uma notata
19. Holbrookia maculata approximans
20. Holbrookia texana
21. Callisaurus ventralis
22. Uta stansburiana
23. Uta ornata
24. Uta graciosa
25. Sceloporus jarrovii
26. Sceloporus clarkii
27. Sceloporus magister
28. Sceloporus consobrinus
*29. Sceloporus scalaris
30. Phrynosoma hernandesi
31. Phrynosoma solare
*32. Phrynosoma cornutum

*33. Phrynosoma modestum
34. Phrynosoma platyrhinos
35. Phrynosoma m'callii
36. Heloderma suspectum
37. Gerrhonotus kingii
38. Cnemidophorus gularis
*39. Cnemidophorus arizonae
40. Cnemidophorus melanostethus
41. Cnemidophorus tigris
*42. Eumeces obsoletus
*43. Leptotyphlops dulcis
44. Siagonodon humilis
45. Lichanura roseofusca
46. Chilomeniscus cinctus
47. Sonora semiannulata
*48. Sonora episcopa
49. Sonora occipitalis
*50. Gyalopium canum
51. Rhinocheilus lecontei
*52. Heterodon nasicus
53. Salvadora grahamiae
*54. Phyllorhynchus brownii
55. Hypsiglena ochrorhynchus
56. Diadophis regalis
57. Lampropeltis pyrrhomelaena
58. Lampropeltis splendida
*59. Lampropeltis conjuncta
60. Lampropeltis boylii
61. Bascanion flagellum frenatum
62. Bascanion piceum
63. Bascanion semilineatum
64. Bascanion taeniatum
65. Arizona elegans
66. Pituophis catenifer deserticola
67. Thamnophis vagrans
68. Thamnophis eques
69. Thamnophis marcianus
70. Thamnophis megalops
71. Thamnophis angustirostris
72. Trimorphodon lyrophanes

73. Tantilla nigriceps
74. Tantilla wilcoxi
75. Elaps euryxanthus
*76. Sistrurus catenatus edwardsii
77. Crotalus molossus
78. Crotalus atrox
79. Crotalus tigris
80. Crotalus confluentus
81. Crotalus oregonus
82. Crotalus cerastes
83. Crotalus mitchellii
84. Crotalus lepidus
85. Crotalus pricei
*86. Crotalus willardi

Notes on the Species in the Collection of the Academy

2.—**Hyla arenicolor** Cope

Forty-three adult specimens are at hand, and the collection includes also some tadpoles and young. In Pima County this tree-toad was collected at East Sabino Basin, June 19, 1912; in Pima Canyon, June 7, 1908; at the steam pump eighteen miles north of Tucson, May 16–18, 1912—all in the Catalina Mountains. In Cochise County this species was found in Ramsey Canyon in the Huachuca Mountains, July 7, 1912. In Maricopa County some were secured at Cave Creek, April 17, 1910; and in Coconino County three were caught at Oak Creek, Sept. 2–4, 1912. They usually were found sitting on boulders in rocky streams.

3.—**Bufo lentiginosus woodhousii** Girard

We have secured twenty-one adults and a number of young toads of this kind. Of these, eight are from Yuma, Sept. 10–21, 1912, and Dec. 31, 1909; three from Phoenix, March 16, 1910, and Sept. 13, 1912; five were collected at Cave Creek, April 2—Sept. 14, 1910; and five were caught at Fairbank, August 12–18, 1912. At Yuma, they were found at night under the electric lights.

4.—**Bufo punctatus** Baird and Girard

We have at hand only five Arizonan specimens of this toad. Nos. 17581, 17582, and 20871 were collected at Cave Creek, Maricopa County, May 16–27, 1910. No. 33847 was found by Mr. Herbert Brown in the foothills of the Catalina Mountains, 18 miles northwest of Tucson, Pima County. No. 35002 was secured in Ramsey Canyon, Huachuca Mountains, Cochise County, July 7, 1912.

5.—**Bufo alvarius** Girard

Thirty-one examples of this little-known toad are now before us. Twenty-six of these (33728 to 33752 and 33799) were caught at Yuma, Sept. 10–21, 1912. Many of these are young, showing the characteristic spotted style of coloration which disappears with age. Nos. 13166 to 13168 were secured in Phoenix, July 10–12, 1907. Two very large specimens (Nos. 35322 and 35323) were collected on the desert close to Tucson, August 22, 1912.

6.—**Bufo cognatus** Say

Forty-six toads (Nos. 33753 to 33798) of this species were collected at Yuma, Sept. 10–21, 1912. We did not find this toad at Tucson, although it is known to occur there, but we have seen specimens from Phoenix. The Yuma specimens were caught at night under the electric street lights.

7.—**Scaphiopus couchii** Baird

This spade-foot toad was found by us only at Fairbank, Cochise County, where eight specimens (Nos. 35227 to 35234) were collected August 12–18, 1912. They were caught in the water in a cattle-guard on the railroad. This species is said to be common at Tucson.

9.—**Rana pipiens** Schreber

We have about one hundred and thirty adult specimens of this frog from Arizona, besides eggs and many tadpoles. Most of these are from the Santa Cruz River at Tucson, but the species was found also at Yuma, Yuma Co.; Oak Creek, Coconino Co., Sept. 1–3, 1912; Cave Creek, Maricopa Co., April 2—May 27, 1910; Phoenix, Maricopa Co., March 11–31, 1910; Sabino Canyon, Santa Catalina Mountains, April 4 and

June 19, 1912; at the steam pump eighteen miles north of Tucson, Pima Co., May 16–18, 1912; and at Fairbank, Cochise Co., August 13–17, 1912. Eggs were found at Tucson, March 25, 1912; and large tadpoles were taken at the same time.

10.—**Kinosternon sonoriense** Le Conte

We have secured twenty Arizonan specimens of this mud-turtle. Two (Nos. 17282 and 20643) were collected at Cave Creek, Maricopa Co., April 19 and June 29, 1910. One (No. 35157) was caught at Fairbank, Cochise Co., Sept. 1912. The other seventeen (33850 to 33866) are from the Santa Cruz River, near Tucson, April 17—June 4, 1912. This species lives also in the Colorado River at Yuma, whence we have a specimen (No. 33403) from the Californian side of the river, collected April 8, 1912. This turtle has been recorded also from Ash Creek, Guadalupe Canyon, Sabino Canyon in the Santa Catalina Mountains, and from the Huachucas.

Yarrow recorded a specimen from Ft. Yuma, California, as *Cinosternum flavescens;* but I know of no evidence that this species occurs in Arizona. Certainly all of the Yuma specimens sent to the Academy—six or eight before the fire—have been *Kinosternon sonoriense.*

It would seem that this turtle is generally distributed throughout the Gila River and its tributaries. Whether it ascends the Colorado River above the Gila is not known.

Captive specimens ate meat voraciously under water. The Tucson specimens were caught with hook and line baited with meat.

11.—**Terrapene ornata** (Agassiz)

The specimen of this turtle collected by Mr. Price at Fort Lowell, near Tucson, June 10, 1893, has remained the only Arizonan record of this box tortoise. We now have at hand eight alcoholic specimens (Nos. 35148 to 35155) and one skull (No. 33156) from Fairbanks, Cochise County, August, 12–18, 1912. These specimens were found in the grass and weeds along an old railroad track about a mile out of town. Some of these turtles have the plates of the carapace nearly smooth, while others are striated. Some are nearly unicolor, while others are very distinctly rayed.

12.—**Gopherus agassizii** (Cooper)

Although it has long been known that this turtle is common in Arizona, we have found only two definite records of localities where it has been taken. Cox mentioned its presence near Tucson, and Ditmars records a specimen secured near Phoenix. Mr. Herbert Brown sent us a fine large pair from Ehrenburg, Yuma County, but these unfortunately were destroyed in the great San Francisco fire of April, 1906. Mr. Brown tells us that this species is fairly common in the Tortolita and Santa Catalina Mountains, in Pima County.

Our collection includes six specimens. These are one young specimen from Yuma; one (No. 13165) taken twenty miles west of Tucson, March 9, 1908; a half-grown specimen (No. 33867) and an adult (No. 33868) from the desert near Tucson; and two young (Nos. 34263 and 34264) found near the steam pump eighteen miles north of Tucson, May 15, 1912.

13.—**Coleonyx variegatus** Baird

We collected fifty specimens of this gecko during the spring and summer of 1912. Eleven (Nos. 33491 to 33501) were found at Yuma, March 11–19. Three (Nos. 35341 to 35343) were secured at Gunsight, Pima Co., April 16–22. Thirty-six (Nos. 33890 to 33925) were collected near Tucson, April 8–13.

At Yuma they were found on the desert under tin cans, old clothes, boards, and stones. The Gunsight and Tucson specimens were found under stones. Near Tucson they seemed to live in colonies near the tops of certain low rolling desert hills near the lower edge of the giant cactus belt. On some of these hills we found six or eight specimens under stones six to twenty inches in diameter, while on other similar hills none could be found, although nearly every suitable stone was turned. Later in the season we could find none, and it is probable that they descend into holes as the ground dries and the weather becomes warmer. They often utter a little squeak when caught.

No. 33922, Tucson, March 26, 1912, in life was colored as follows: Limbs dark flesh. Dark markings on head; body and tail deep liver brown. Light markings on tail and body bright lemon yellow, on head grayish yellow. Lower surfaces of head, body, and limbs pure white, of tail light lemon yellow.

14.—**Dipsosaurus dorsalis** (Baird and Girard)

Our present collection contains seventy specimens of this lizard. Sixty-seven of these were collected at Yuma, March 11–21, 1912, and June 8–25, 1910. One (No. 34209) was shot at Papago Wells, Yuma Co., April 16–22, 1912. Two (Nos. 17284 and 17285) were secured at Cave Creek, Maricopa County, April 20, 1910.

Of these specimens, sixty-two have the rostral separated from the nasal on each side by two granules, one has two on one side and none on the other, while six have but one granule intervening on each side. The femoral pores vary from 18 to 26; being 18 five times, 19 thirteen times, 20 twelve times, 21 twenty-one times, 22 twenty-two times, 23 twenty-nine times, 24 seventeen times, 25 nine times, and 26 three times.

15.—**Sauromalus ater** Duméril

The single Arizonan specimen (No. 17645) in our collection was secured near Cave Creek, Maricopa Co., July 19, 1910. Its femoral pores are 16–17. I have seen a specimen secured near Tempe, Maricopa Co., and we caught a young one (No. 33446) March 18, 1912, on the California side of the Colorado river a few miles below Yuma.

16.—**Crotaphytus collaris baileyi** (Stejneger)

One (No. 34321) was collected May 7, 1912, in the foothills of the Catalina Mountains, near the steam pump eighteen miles north of Tucson. Eight (Nos. 35128 to 35135) were secured August 6–8, 1912, at Cave Creek, Chiricahua Mountains, Cochise County. These lizards are very timid. They seem to come out late in the afternoon, and then appear on the tops of boulders, where they may be seen bobbing up and down as many lizards do. This seems to be distinctively a rock-loving species, while *C. wislizenii* is found on the ground.

The femoral pores in these specimens vary from 14 to 19; being 14 once, 15 twice, 16 five times, 17 five times, 18 four times, and 19 once.

17.—**Crotaphytus wislizenii** Baird and Girard

Nine of these lizards were collected by us. Two were shot near Yuma, No. 33490, March 19, 1912, and 33686 Sept. 9,

1912. Five were secured at Papago Wells in southeastern Yuma Co., April 16–22, 1912. One (No. 17283) was caught in Paradise Valley, Maricopa Co., May 9, 1910. No. 34320 was found at the steam pump eighteen miles north of Tucson, May 18, 1912. One was seen chasing a *Callisaurus* on the desert.

In eight specimens the femoral pores vary from 19 to 25; being 19 three times, 20 twice, 21 once, 22 four times, 23 three times, 24 twice, and 25 once.

18.—**Uma notata** Baird

Our present collection contains only one *Uma*. This is No. 20812, and was collected near Yuma, June 13, 1910. We failed to find any here in March and in September, 1912, although careful search was made on the same sand hills where Mr. Carlson shot more than forty for us in 1905. These specimens secured by Mr. Carlson were destroyed in the great San Francisco fire of April, 1906. It is probable that there is only one species of *Uma*. We were unable to find this lizard near Tucson.

19.—**Holbrookia maculata approximans** Baird

Twenty-seven Arizonan specimens are at hand, collected at Tucson, April 16—Sept. 3, 1912; Fairbank, August 12, 1912; Cave Creek in the Chiricahua Mountains, Cochise Co., August 6, 1912; and on the desert near the mouths of Ramsey and Carr Canyons, Huachuca Mts., Cochise Co., June 28—July 29, 1912. This *Holbrookia* was found always on the ground out on the open desert, while the other species secured frequents canyons and hillsides, and is usually seen on top of large stones or boulders.

Femoral pores in twenty-five specimens vary from eight to sixteen; being 8 twice, 10 seven times, 11 four times, 12 ten times, 13 fourteen times, 14 seven times, 15 three times, 16 twice.

20.—**Holbrookia texana** (Troschel)

This *Holbrookia* was recorded as Arizonan on the evidence of a single specimen collected by Mr. Price in 1894. We now have at hand forty-five specimens of various ages. Thirty-four were secured in the Catalina Mountains, where they were

found at the steam pump eighteen miles north of Tucson, and in Ventana and Sabino Canyons, April 4—May 2, 1912, and eleven were collected at Cave Creek, Maricopa County, April 4—May 27, 1910.

This lizard is easily distinguished from *H. maculata approximans* by black cross-bars on the lower surface of the tail, and large blue patches on the sides of the belly. Its habit of constantly wanting to get up on the tops of boulders attracts attention to it in life. It is a larger species than *H. m. approximans,* being about equal in size to *Callisaurus ventralis* which it much resembles.

Femoral pores vary from 11 to 18; being 11 once, 12 twice, 13 seven times, 14 eighteen times, 15 twenty-two times; 16 ten times, 17 five times, and 18 three times in thirty-four specimens from the Catalina Mountains.

21.—**Callisaurus ventralis** (Hallowell)

Three hundred and eighty-seven Arizonan specimens of this species are before us. One hundred and thirty of these are from Yuma, Feb. 7–28, 1910, March 11–21, 1912, June 8–24, 1910, and Sept. 9–17, 1912. Sixteen were shot at Papago Wells, Yuma Co., April 16–22, 1912. Two were secured at Growler Well, and four at Ajo in western Pima Co., April 16–22, 1912. One hundred and thirty-one were collected at Cave Creek, Maricopa Co., April 2—May 14, 1910. Three were preserved at Phoenix, March 16–22, 1910; and others were found at Tucson, April 1–13, 1912, at the steam pump in the foothills of the Catalina Mts., 18 miles north of Tucson, May 3–18, 1912; at Ventana Canyon, Catalina Mts., June 14, 1911; at old Fort Lowell, March 29, 1912; and at Agua Caliente, six miles east of Fort Lowell, May 14, 1911.

Femoral pores in forty-one specimens range from 11 to 21; being 11 once, 13 once, 14 four times, 15 fifteen times, 16 thirteen times, 17 twenty-one times, 18 twelve times, 19 four times, 20 five times, 21 twice.

22.—**Uta stansburiana** Baird and Girard

Ninety-eight specimens from Arizona are at hand. They were secured: forty-four at Yuma, March 11–21, 1912, Sept. 10–17, 1912, Dec. 4, 1910; fifteen at Papago Wells, Yuma County, April 16–22, 1912; four at Ajo, western Pima County,

April 16–22, 1912; eight at Tucson, March 28—April 13, 1912; three at the steam pump eighteen miles north of Tucson, May 8–18, 1912; five at old Fort Lowell, March 29—April 4, 1912; one from the Catalina Mts., Pima County; sixteen at Cave Creek, Maricopa County, April 5—May 17, 1910; and two from Dome, Yuma County, Jan. 20 and 21, 1910.

The femoral pores in forty specimens, mostly from Yuma County, vary from twelve to seventeen; being 12 four times, 13 ten times, 14 twenty-six times, 15 twenty-seven times, 16 seven times, 17 once.

All styles of coloration are to be seen in this series. Some have longitudinal light stripes, some have dark dorsal blotches, some are without large markings, but are sprinkled with small blue spots. A living male from Palm Springs, Cal., showed these various types of coloration at different times.

23.—**Uta ornata** Baird and Girard

More than three hundred and sixty specimens of these tree Utas are at hand. After careful comparison of individuals from Yuma and from eastern Arizona we are unable to detect any constant difference nor are we able to distinguish Arizonan examples from the few specimens from Texas which we have for comparison. We, therefore, make use of the name *Uta ornata* for all these lizards, and regard *Uta symmetrica* as a synonym. Our specimens are from the following localities:

Yuma County—Yuma and Papago Wells.

Maricopa County—Cave Creek.

Coconino County—Oak Creek.

Pinal County—Oracle.

Pima County—Tucson, Fort Lowell, and in the Catalina Mountains at the steam pump 18 miles north of Tucson, in Ventana and Sabino Canyons, and in East Sabino Basin.

Santa Cruz County—Mowry in the Patagonia Mountains.

Cochise County—Fairbank, the vicinity of Ramsey Canyon in the Huachuca Mts., and at Cave Creek and Paradise in the Chiricahua Mts.

The femoral pores in forty specimens from Yuma vary from ten to fifteen; being 10 three times, 11 eighteen times, 12 thirty-four times, 13 seventeen times, 14 seven times, and 15

once. The average for the eighty thighs is 11.51. In forty specimens from Pima and Cochise counties the number varies from nine to thirteen; being 9 once, 10 eight times, 11 thirty times, 12 thirty-one times, and 13 ten times. The average for the eighty thighs is 12.12.

In Yuma specimens the color in life in both sexes varies on the upper surfaces from light clay to blackish brown. Most males show the blackish collar and dorsal blotches much more clearly than females. Males have a blue area on each side of the belly, absent in nineteen females. One large male had deep "iron rust" orange covering the entire throat and chin. A smaller male had similar coloring of the throat but with a bright turquoise blue central patch. Five large and two medium-sized males had throats bluish yellow, varying, without respect to size, from nearly clear blue to faintly bluish lemon yellow. One large and one small male had clear lemon yellow throats. One moderately large male had the throat gray without blue or yellow or orange. Nineteen females had no blue on the throat or sides of belly. Eight females had orange-colored, and eight had lemon-colored, throats; while one large and one small female had the throat orange with lemon center.

The coloring of living specimens from Tucson shows a similar variation. Females have no blue on belly. Males have. The blue of the throat varies from clear turquoise to the green-blue of old turquoises. The throat is blue in thirteen males; orange in eight females; clear yellow in three males and six females; orange with yellow center in seven males; orange with blue center in eight males; orange with green center in one male; and plain gray in one female. These color notes were all made in March, 1912.

At Yuma, these lizards are very common on trees and wooden bridges. At Tucson, we found them on trees, fences, and piles of stones.

24.—**Uta graciosa** (Hallowell)

This species still remains rare in collections. We secured only eight specimens, all at Yuma, in Sept. 1911, and March 11–21, 1912. These are Nos. 20722 and 33643 to 33649. Their femoral pores range from nine to twelve; being 9 once,

10 five times, 11 seven times, and 12 once. Some were found lying along the limbs of mesquite trees and some were in low, thick-growing bushes on the sand hills east of Yuma.

25.—**Sceloporus jarrovii** Cope

Our collections include one hundred and forty-three specimens. These were collected in Carr, Ramsey and Miller Canyons in the Huachuca Mts., June 30—July 25, 1912; and in the vicinity of Paradise, Chiricahua Mts., August 4–9, 1912. These lizards are found on rocks in the oak and conifer belts, and range up to eight thousand feet in the Huachucas. They are not so common in the Chiricahuas as in the Huachucas.

The femoral pores in forty specimens vary from thirteen to eighteen; being 13 three times, 14 twenty-three times, 15 twenty-one times, 16 seventeen times, 17 thirteen times, and 18 twice.

The color of *Sceloporus jarrovii* in life is as follows: In an adult male, the collar is blue-black with some brilliant blue extending up from the throat near its anterior edge. The scales of the back and sides of body are outlined with black while the central portion of each scale is light, and in different lights appears white, gray, green, yellow, or irridescent bronze. The head, limbs, and tail are dark brown much relieved with malachite green. A whitish or irridescent bronze line runs back from the eye. Another runs along the upper lip to the ear. A similarly colored longitudinal bar extends forward on each side of the neck from the collar, and a band of the same tint, a scale in width, borders the collar behind except in the middorsal region. The collar is complete across the neck, and has a brownish continuation forward on the middle of the neck to the head. The chin, lower surfaces of the limbs and tail, and the center of the chest and belly are gray. The entire gular region and a stripe along each side of the belly are deep blue, the belly patches shading to malachite green laterally.

Females and young are similarly but less clearly and brightly marked, particularly as regards the light centers of the scales, the intense black collar, and the blue of the inferior surfaces. In young specimens the predominant color is brown; though the characteristic collar shows in even the smallest specimens. The blue throat patch always is single.

26.—**Sceloporus clarkii** Baird and Girard

We have secured eighty specimens of this lizard. Twenty-three of these are from Tucson, where they were shot between March 28 and April 24, 1912. Two (Nos. 20951 and 20952) are from old Fort Lowell. Seventeen were collected in the foothills of the Catalina Mountains, near the steam pump eighteen miles north of Tucson, May 2–18, 1912. One (No. 34685) was taken in the Catalina Mts., at an elevation of 8500 feet on the trail to Mt. Lemon, May, 1912. At Oracle, Pinal Co., two specimens (Nos. 34167, 34168) were caught April 2 and 3, 1912. Mr. Herbert Brown gave us five (Nos. 33819 to 33823) from the Patagonia Mountains, Santa Cruz Co., July 11–21, 1910. Five of these lizards (Nos. 35179 to 35183) were collected at Fairbank, Cochise Co., Aug. 13–18, 1912. From the Huachucas we have twelve specimens (Nos. 34882 to 34893) taken in the lower portions of Ramsey, Carr, and Miller Canyons, July 2–29, 1912. Mr. Slevin collected fourteen in the Chiricahua Mountains, one (No. 35141) from Cave Creek, and thirteen (Nos. 35005 to 35017) from Paradise, August 4–8, 1912.

The femoral pores in thirty-eight specimens vary from eleven to fifteen; being 11 fifteen times, 12 thirty-three times, 13 seventeen times, 14 nine times, and 15 twice. The average of the seventy-eight thighs is 12.34.

At Oracle these lizards were found in cracks in the granite boulders. The one from Mt. Lemon was also taken on a boulder. Nearly all the others were found on trees—at Tucson on willows along the Santa Cruz River, in the foothills of the Catalinas on mesquites, in the Huachucas and Chiricahuas on oaks and pines. Those taken at Fairbank were under the eaves of an old adobe barn. They sometimes climb trees to a height of thirty or forty feet.

27.—**Sceloporus magister** Hallowell

Nineteen Arizonan specimens are in the collection. Nos. 33488 and 33489 were found in an old adobe house at Yuma, March 11–16, 1912. In Maricopa County this species was collected (No. 17286) at Paradise Valley, and (Nos. 17287 to 17289 and 20718) at Cave Creek, May 14–19, 1910. Two (Nos. 34054 and 34057) were secured near Tucson, April 1–

16, 1912. Ten were taken near the steam pump in the foothills of the Catalina Mts., eighteen miles north of Tucson, April 28—May 18, 1912.

Femoral pores in seventeen specimens vary from eleven to fifteen; being 11 eight times, 12 thirteen times, 13 nine times, and 14 four times. The average in the thirty-four thighs is 12.23.

At Tucson this species was found on willow trees in the river-bed, while at the steam pump they frequented the wooden fences about the corral.

28.—**Sceloporus consobrinus** Baird and Girard

Thirty-one (Nos. 35037 to 35067) were secured near Paradise in the Chiricahua Mts., August 4–10, 1912. This lizard was found also in a wash on the desert near the mouth of Ramsey Canyon, Huachuca Mts., July 2, 1912. Four (Nos. 34686 to 34689) were collected at 8500 feet on Mt. Lemon, Santa Catalina Mts., June 4–17, 1912. Nineteen were caught in the river-bed at Tucson, March 24 to April 5, 1912. This species was taken also at Oak Creek, Coconino Co., Sept. 1–4, 1912.

The femoral pores in thirty-one specimens vary from twelve to nineteen; being 12 four times, 13 seven times, 14 nine times, 15 thirteen times, 16 twelve times, 17 nine times, 18 five times, and 19 three times. The average of the sixty-two thighs is 15.35.

30.—**Phrynosoma hernandesi** (Girard)

We have forty-two specimens of this horned toad. Thirty-one of these (Nos. 34691 to 34721) are from the top of Mt. Lemon in the Catalina Mountains, where they were collected June 4–17, 1912. Mr. Herbert Brown gave us six (Nos. 33827 to 33832) from Manning Camp, Rincon Mountains, August 17–22, 1911, and states that they are extremely common in this locality. Nos. 35001 and 35004 were collected in the pine belt in Carr Canyon, Huachuca Mts., July 10–27, 1912. Nos. 35098 and 35099 were found in the pine belt at Paradise in the Chiricahua Mts., Cochise Co., Aug. 4–10, 1912. No. 35292 was caught at Ash Fork, Yavapai Co., Aug. 30, 1912.

One of the specimens from Mt. Lemon has the occipital horns as Dr. Stejneger describes them to be in *P. ornatissimum.*

We therefore regard this name and *P. hernandesi* as synonyms. In southern Arizona this lizard seems to be confined to the higher levels of the mountains. A large female taken in the Huachucas in July contains a number of young, showing that this species is ovoviviparous.

Femoral pores in twenty specimens vary from eleven to nineteen; being 11 once, 12 six times, 13 three times, 14 eleven times, 15 eight times, 16 four times, 17 three times, 18 once, 19 once.

31.—Phrynosoma solare Gray

Twenty-three specimens are at hand. No. 35185 was collected at Fairbank, Cochise Co., August 12, 1912. No. 20933, was caught at Fort Lowell. Four were secured at Tucson May 30—Aug. 23, 1912, and one June 29, 1911. No. 34322 was found at the steam pump in the foothills of the Catalina Mountains, eighteen miles north of Tucson, July 9, 1912. The other fifteen are from Phoenix, where they were collected March 15—June 6, 1910.

Femoral pores in twenty specimens vary from fourteen to twenty-six; being 14 once, 15 once, 17 twice, 18 four times, 19 three times, 20 eight times, 21 eight times, 22 six times, 23 five times, 24 once, 26 once. Unlike the preceding, this horned toad is a desert species.

34.—Phrynosoma platyrhinos Girard

Two specimens (Nos. 34210, 34211) were caught at Papago Wells, in the southeastern part of Yuma County, April 16–22, 1912. Femoral pores are 7–6 and 9–7.

35.—Phrynosoma m'callii (Hallowell)

Three specimens (Nos. 33486, 33487 and 33657) were collected at Yuma, March 14 and 15, and Sept. 12, 1912. All were secured on the sand hills east of town. One was found sitting on an ant hill, but not an ant was in sight although a half hour later they were swarming over it. It seemed as though the ants remained under cover in the nest as long as the lizard was watching for them. Femoral pores are 18–19, 21–23, and 18–18.

36.—Heloderma suspectum Cope

Our collections include twenty Gila Monsters. No. 35301, was caught in a wash on the grounds of the Desert Laboratory,

Tucson, at about five in the afternoon, August 23, 1912. No. 34061, was secured thirty miles west of Tucson, April 25, 1912. No. 34198, was taken in Ventana Canyon, Catalina Mountains, April 28, 1912. Eleven (Nos. 34283 to 34293) were collected near the steam pump in the foothills of the Catalina Mountains, eighteen miles north of Tucson, May, 1912. No. 35000 was caught in Ramsey Canyon, Huachuca Mts., July 27, 1912. Three (Nos. 17642 to 17644) were found at Cave Creek, Maricopa County, May, 1910. No. 17641 is from Paradise Valley, Maricopa Co., May 1910. No. 13169 is labeled merely Arizona.

Helodermas were found out at any time of day. They were found in the giant cactus, creosote bush, and oak belts. All found were merely walking about. They hasten their gait when one approaches them, but were never seen to run. Two put in a pillow case and hung in a tree, scratched a hole through the cloth and escaped. The species still is common in favorable locations.

37.—**Gerrhonotus kingii** Gray

We have five specimens of this handsome lizard (Nos. 34962 to 34966) secured in Ramsey and Carr Canyon in the Huachuca Mountains, Cochise County, July 3 to 29, 1912. They were found in the oak belt, on the ground among stones and dead leaves, walking about in the day time, and were very shy. All five have fourteen longitudinal rows of dorsal scales, of which three rows on each side of the middorsal line are weakly keeled except in No. 34963, which has four keeled rows on each side. The dorsal scales in a row from the interoccipital plate to the backs of the thighs are 45, 48, 50, 51, 52. On the belly one counts in a row from the mental plate to the anus 55, 58, 53, 59 and 60. Three have ten dark cross-bands on the body, while one has nine and one eleven. The dark bands on the tail vary in number from fourteen to nineteen.

38.—**Cnemidophorus gularis** Baird and Girard

We have secured one hundred and eighty-six of these lizards. These are: thirty-three from the vicinity of Paradise and Cave Creek, Chiricahua Mts., August 4–10, 1912; sixty-eight from the lower parts of Ramsey, Miller, and Carr Canyons in the Huachuca Mts., July 2–30, 1912; fifteen from Fairbanks,

Aug. 12–18, 1912; one from an altitude of 8500 feet on Mt. Lemon in the Catalina Mts., June 4 to 17, 1912; forty-six from the steam pump in the foothills of the Catalina Mts., eighteen miles north of Tucson, May 2–18, 1912; nineteen from Tucson, March 31—June 23, 1912; three from Fort Lowell near Tucson; and one (No. 35286) from Oak Creek, Coconino Co., Sept. 4, 1912.

The femoral pores in forty specimens vary from fifteen to twenty; being 15 once, 16 eight times, 17 twenty-one times, 18 thirty-four times, 19 thirteen times, and 20 three times. The average of the eighty thighs is 17.7.

Our series from Tucson and the steam pump include a number of very large individuals with the coloration typical of the form which has been called *C. scalaris*. As we have also specimens intermediate in size and coloration, it would appear that *C. scalaris* is based upon very old individuals of *C. gularis*.

Some young specimens from Fairbank show a distinct median dorsal light line. While none of these specimens has the nasal in contact with the second labial, this relation is found on one side of the head in a specimen with the coloration usually seen in young *C. gularis*. It may possibly be, therefore, that *C. arizonae* is based upon an abnormal individual of *C. gularis*, which differed from the usual type in coloration, in the relations of the nasal and second labial plates, in the number of femoral pores, and in the size of the postantebrachial plates.

40.—**Cnemidophorus melanostethus** (Cope)

Our collections include one hundred and fifty-nine specimens of this lizard. Of these, two were secured at Fairbank, Cochise Co., August 12–14, 1912; one from Pima Canyon, Catalina Mts., June 7, 1908; seventy-six from near the steam pump in the foothills of the Catalina Mts., eighteen miles north of Tucson, May 2–18, 1912; six from Tucson, April 24—June 23, 1912; three from Fort Lowell near Tucson; one from Gunsight, western Pima Co., April 16–22, 1912; and seventy from Cave Creek, Maricopa Co., April 1—August 13, 1910.

The specimen (No. 35340) from Gunsight is a typical one with black throat and chest.

Femoral pores in forty specimens vary from seventeen to twenty-four; being 17 six times, 18 eight times, 19 eighteen

times, 20 twenty-two times, 21 thirteen times, 22 eleven times, 23 once, and 24 once. The average number is 19.87.

41.—**Cnemidophorus tigris** Baird and Girard

Seventy-three Arizonan specimens of this lizard are at hand. Fifty-three of these were collected at Yuma in March, June, September, October, and December. Nineteen were shot at Papago Wells, southeastern Yuma Co., April 16–22, 1912. One (No. 35328) was secured at Ajo, Pima County, April 16–22, 1912. None of these specimens have black throats and chests, although these regions may be slaty with a few black spots. The specimen from Ajo is as typical as the others, although this locality must be near the eastern limit of the range of this form, for typical *C. melanostethus* was collected at Gunsight, Pima Co., only about forty miles southeast.

Femoral pores in forty of these specimens vary from seventeen to twenty-five; being 17 three times, 18 four times, 19 ten times, 20 fourteen times, 21 eighteen times, 22 eleven times, 23 nine times, 24 four times, 25 twice, and 5 injured. The average number is 20.89, as against 20.4 in forty specimens from Yuma recorded in a former paper.

43.—**Leptotyphlops dulcis** (Baird and Girard)

We did not collect any specimens of this worm snake. So far as we can learn it has not been recorded from Arizona; but its occurrence there was shown by a typical specimen which Mr. Herbert Brown collected at Yuma and sent to me a short time before the great San Francisco fire of April, 1906, in which the specimen unfortunately was destroyed. Professor Brown of the University of Arizona told us that he had seen both kinds of worm snakes at Tucson, this species being represented by a single specimen collected on the grounds of the Carnegie Desert Laboratory in 1911.

44.—**Siagonodon humilis** (Baird and Girard)

We have at hand four specimens from Arizona. Three are from Tucson. Nos. 33835 and 33836, collected April 17, 1895, and No. 35325 without date were presented to us by Professor Brown of the University of Arizona. The fourth specimen, No. 33849, was collected about the middle of May, 1912, in the foothills of the Catalina Mts., about eighteen miles northeast of

Tucson by Mr. Herbert Brown. It was found under a stone about a foot square, and about twenty feet from the edge of a pool of water. Under the stone the earth had been worked from between the grass roots, showing several runways in one of which this snake was coiled up.

The largest specimen we have seen is in the University of Arizona, and measures 384mm., of which 16mm. represent the tail. It was secured by Mr. Herbert Brown at Yuma.

45.—**Lichanura roseofusca** Cope

Cope has recorded this boa from the Harqua Halla Mountains. Mr. W. E. Bancroft writes us that he has seen this snake only in these mountains and in the Harcouvar Range in northern Yuma County. He very kindly sent us a beautiful specimen from Aguila, Maricopa County. This is now No. 35348, and has scales in 36–41–41–33 rows, gastrosteges 230, urosteges 47, anal entire, supralabials 14–15, infralabials 15–15, loreals about 4.

46.—**Chilomeniscus cinctus** Cope

The collection contains five specimens of this snake. Two of these (Nos. 33839 and 33840) were presented by Professor Brown of the University of Arizona, and are labeled merely Arizona.

No. 33834, Cabali Mts., Pima County, given to us by Mr. Herbert Brown, was collected Nov. 2, 1910. No. 34172 was collected in Ventana Canyon, Catalina Mts., May, 1912. No. 17551, Cave Creek, Maricopa County, April 23, 1910, was collected by John I. Carlson. A mutilated specimen was found by us near Fort Yuma, California.

No. 17551 has scales in 13 rows, gastrosteges 113, anal divided, urosteges 29, supralabials 7–7, infralabials 8–8, preoculars 1–1, postoculars 2–2, loreals 0–0, temporals 1+1, posterior genials shorter, black bands 18 on body and four on tail.

No. 33834 has scale rows 13, gastrosteges 113, anal divided, urosteges 22, supralabials 7–7, infralabials 8–8, preoculars 1–1, postoculars 2–2, loreals 0–0, temporals 1+1, posterior genials shorter, black bands 18 on body and 3 on tail.

No. 33839 has scale rows 13, gastrosteges 115, anal divided, urosteges 28, supralabials 7–7, infralabials 7–7, preoculars 1–1,

postoculars 2–2, loreal 0–0, temporals 1+1, posterior genials shorter, black bands 19 on body and 4 on tail.

No. 33840 has scale rows 13, gastrosteges 121, anal divided, urosteges 23, supralabials 7–7, infralabials 7–7, preoculars 1–1, postoculars, 2–2, loreals 0–0, temporals 1+1, posterior genials shorter, black bands 21 on body and 4 on tail.

No. 34172 has scale rows 13, gastrosteges 122, anal divided, urosteges 25, supralabials 7–7, infralabials 7–6, preoculars 1–1, postoculars 2–2, loreals 1–1, temporals 1+1, posterior genials shorter, black bands 20 on body and 4 on tail.

In life the dorsal portions of the white rings are suffused with reddish orange.

The black bands are not so widely separated as in *Sonora occipitalis*. No. 34172 has a well developed loreal on each side of the head, but in other respects is quite typical.

In No. 17551, the prefrontal reaches the labials on one side of the head but not on the other, where the postnasal and preocular are in contact.

No. 33834 has the prefrontals separated from the labials by the meeting of the postnasal and preoculars. No. 34172 has them separated by the intervening loreals. The other two specimens have the prefrontals and labials in contact.

We, therefore, cannot recognize Cope's *Chilomeniscus ephippicus* as distinct from his *C. cinctus*.

47.—**Sonora semiannulata** Baird and Girard

There can be be no doubt that the snake described under this name by Baird and Girard is the same species as Cope's *Contia* or *Chionactis isozonus*. This being true, both the generic and specific names of Baird & Girard must replace those later suggested by Cope. Hallowell's *Lamprosoma* seems not to be generically distinct, although the species *occipitale* is so. We thus have in Arizona three species of *Sonora* as follows:

Sonora semiannulata=*Chionactis isozonus*
Sonora episcopa =*Chionactis episcopa*
Sonora occipitalis =*Chionactis occipitalis*

We have seen no evidence of intergradation of these forms, and therefore regard them all as species, although Cope states that intermediate types of coloration connect the first two forms.

We have at hand only one specimen of *Sonora semiannulata,* No. 17550, collected at Cave Creek, Maricopa Co., April 20, 1910. It agrees in all essential particulars with the description and plate given by Baird and Girard, and with the description by Cope, except in the number of its black dorsal cross-bands, which are forty on the body and ten on the tail. This is about twice as many as in the specimens recorded by these authors.

This specimen has 15 scale rows, gastrosteges 168, anal divided, urosteges 45, superlabials 7–7, infralabials, 7–7, preoculars 1–1, postoculars 2–2, loreal 1–1, temporals 1+2, posterior genials much shorter. The black bars each occupy about the length of two or three scales, and are separated by slightly greater light intervals. These intervals are yellowish white laterally with dark spots at the bases of the scales, while the central dorsal portions are pinkish anteriorly, becoming reddish orange toward and on the tail. The length to anus is 230mm., of the tail 56mm.

48.—**Sonora episcopa** (Kennicott)

Our collection contains no specimens of this pretty little snake. Mr. Herbert Brown showed me one in the collection of the University of Arizona. This specimen was collected at Yuma, and has scales in fourteen rows, gastrosteges 173, urosteges 47, loreal 1–1, and the typical coloration.

I have described elsewhere (Proc. Cal. Acad. Sci., (4), III, 1912, p. 153) two specimens from Yuma, which are in the collection of Stanford University. These had scales in 15 rows, gastrosteges 169, 168, anal divided, and urosteges 45, 47.

49.—**Sonora occipitalis** (Hallowell)

A fine specimen (No. 33451) was dug out of the sand at the base of a bush on a dune two or three miles east of Yuma, March 19, 1912. It was about a foot below the surface.

In life, the dark rings were pure black, and between each pair of black rings was a transverse bar or half ring of cadmium orange, of about the same width on the midline as the black rings, and separated from them by a nearly equal space, which was pale lemon yellow. This lemon tint extended down on to the sides, and the lower surfaces were a paler lemon.

This specimen has 15 scale rows, gastrosteges 164, anal divided, urosteges 51, supralabials 7–7, infralabials 7–7, pre-

oculars 1–1, postoculars 2–2, loreals 1–1, temporals 1+2, posterior genials very small, black bars 21 on body and 8 on tail.

A second specimen (No. 33809) from Yuma, presented by Mr. Herbert Brown, has scale rows 15, gastrosteges 167, anal divided, urosteges 22+, supralabials 7–7, infralabials 8–8, preoculars 1–1, postoculars 2–2, loreals 1–1, temporals 1+2, posterior genials very small, black bars 22 on body.

51.—**Rhinocheilus lecontei** Baird and Girard

No. 35295, Desert Laboratory, Tucson, June 20, 1912.—Scale rows 23, gastrosteges 197, anal entire, urosteges 51 last six divided, supralabials 8–8, infralabials 8–8, preoculars 2–2, postoculars 2–2, loreal 1–1, temporals 2+3, posterior genials shorter, 25 dark blotches on body and tail.

No. 33843, Arizona.—Scale rows 23, gastrosteges 193, anal entire, urosteges 50 of which 10 are divided, supralabials 8–8, infralabials 9–9, preoculars 1–1, postoculars 2–2, loreal 1–1, temporals 2+3, posterior genials shorter.

No. 33842, Arizona.—Scale rows 23, gastrosteges 186, anal entire, urosteges 47 of which 12 are divided, superlabials 8–8, infralabials 9–10, preoculars 1–1, loreal 1–1, temporals 2+3.

No. 33844, Arizona.—Scale rows 23, preoculars 1–1, postoculars 2–2, supralabials 8–8.

No. 33838, Tucson, July 22, 1892.—Supralabials 7–8, preoculars 1–1, postoculars 2–2, loreal 1–1, temporals 2+3.

53.—**Salvadora grahamiae** Baird and Girard

The present collection includes six specimens of this snake. The scale counts are as follows:

No. 33453, Yuma, March 14, 1912.—Scale rows 17, gastrosteges 211, anal divided, urosteges 67, supralabials 9–10, infralabials 10–10, preoculars 2–2, postoculars 2–2, loreals 1–1, temporals 2+3, genials equal. This specimen was caught late in the afternoon, as it was traveling along under some bushes on the desert.

No. 33810, Yuma, Herbert Brown.—Scale rows 17, gastrosteges 209, anal divided, urosteges 98, supralabials 9–10, infralabials 9–9, preoculars 1–1, postoculars 3–3, loreal 2–2, temporals 2+2, genials equal.

No. 35296, Tucson, June 20, 1912.—Scale rows 17, gas-

trosteges 195, anal divided, urosteges 73, supralabials 9–9, preoculars 2–2, postoculars 2–2, temporals 2+2–2+3.

No. 33875, Desert Laboratory, Tucson.—Scale rows 17, gastrosteges 202, anal divided, urosteges 80, supralabials 9–9, infralabials 10–10, preoculars 2–2, postoculars 2–2, loreals 1–1, temporals 2+2, posterior genials longer.

No. 34275, steam pump, eighteen miles north of Tucson, May 7, 1912.—Scale rows 17, gastrosteges 200, anal divided, urosteges 80, supralabials 9–9, infralabials 11–12, preoculars 1–1, postoculars 2–2, loreals 1–1, temporals 2+2–2+3, posterior genials longer.

No. 34754, Ramsey Canyon, Huachuca Mts., July 10, 1912. —Scale rows 17, gastrosteges 178, anal divided, urosteges 99, supralabials 8–8, infralabials 10–10, preoculars 2–2, postoculars 2–2, loreals 1–1, temporals 2+2, posterior genials shorter. This specimen was found lying on the ground in a small orchard toward evening.

Mr. Herbert Brown showed us specimens from Pima Canyon, Santa Catalina Mts., Pima Co., and from Mowry, Patagonia Mts., Santa Cruz County.

55.—**Hypsiglena ochrorhynchus** Cope

We have secured only four Arizonan specimens of this snake. These are as follows:

No. 17548, Cave Creek, Maricopa Co., April 6, 1910, John Carlson.—Scale rows 21, gastrosteges 185, anal divided, urosteges 50, supralabials 8–8, infralabials 9–9, preoculars 2–2, postoculars 2–2, loreals 1–1, temporals 1+2, posterior genials longer.

No. 33874, vic. Desert Laboratory, Tucson, March 23, 1912. —Scale rows 21, gastrosteges 175, anal divided, urosteges 57, supralabials 8–8, infralabials 9–9, preoculars 1–1, postoculars 3–3, loreals 1–1, temporals 1+2, posterior genials shorter. This snake was found under a stone.

No. 34276, steam pump, eighteen miles north of Tucson, May 3, 1912.—Scale rows 21, gastrosteges 176, anal divided, urosteges 39+, supralabials 8–8, infralabials 10–10, preoculars 2–2, postoculars 2–2, loreals 1–1, temporals 1+1–1+2. This specimen was found under a tin can in a chicken yard.

No. 35339, Gunsight, western Pima County, April 16–22, 1912.—Scale rows 21, gastrosteges 178, anal divided, urosteges

58, supralabials 8–8, infralabials 10–10, preoculars 1–1, postoculars 2–3, loreals 1–1, temporals 1+2, posterior genials longer. Caught under a stone on the desert.

56.—Diadophis regalis Baird and Girard

A single specimen, No. 34756, was caught in a peach orchard near the pine and oak belts in Ramsey Canyon, Huachuca Mts., July 29, 1912. This snake was found just before dusk as it was entering a hole by the side of a fence post. When opened this *Diadophis* was found to contain a fine large *Tantilla wilcoxi* which it must have just eaten.

Scales are in 17 rows, gastrosteges 212, anal divided, urosteges 72, supralabials 7–7, infralabials 8–8, preoculars 2–2, postoculars 2–2, temporals 1+2, loreal 1–1, posterior genials shorter.

57.—Lampropeltis pyrrhomelaena Cope

Three specimens were secured. No. 34684, from an altitude of 7000 ft. in the pine belt in Bear Canyon, on Mt. Lemon, Catalina Mts., Pima County, has scales in 23 rows, anal entire, urosteges 79, body and tail with 61 yellow rings.

No. 34753, from the pine region in Ramsey Canyon, Huachuca Mts., July 11, 1912, has scales in 23 rows, anal entire, gastrosteges 227, urosteges 78, supralabials 7–7, infralabials 10–11, preoculars 1–1, postoculars 2–2, temporals 2+3, loreal 1–1, posterior genials shorter, body and tail with 48 yellow rings, snout yellow.

No. 35326, from pine woods in Oak Creek Canyon, Coconino County, Sept. 4, 1912, has scales in 23 rows, anal entire, gastrosteges 217, urosteges 70, supralabials 7–8, infralabials 10–10, preoculars 1–1, postoculars 2–3, temporals 2+3, loreal 1–1, posterior genials shorter, body and tail with 60 yellow rings, snout yellow.

60.—Lampropeltis boylii Baird and Girard

A milk snake, No. 17542, collected at Cave Creek, Maricopa County, has white rings without black edging on the scales. It has scales in 25 rows, gastrosteges 226, anal entire, urosteges 48, supralabials 7–7, infralabials 9–9, preoculars 1–1, postoculars 2–2, temporals 2+4, loreal 1–1, posterior genials shorter, thirty-five white rings on body and tail.

61.—**Bascanion flagellum frenatum** Stejneger

The collection includes specimens from Yuma, from Papago Wells close to the southeastern corner of Yuma County, and from Cave Creek, Maricopa County.

No. 34203, Papago Wells, has scale rows 17, gastrosteges 192, anal divided, urosteges 110, supralabials 8–8, infralabials 10–11, preoculars 2–2, postoculars 2–2, temporals 2+2+2, loreal 1–1, posterior genials longer.

No. 17549, Cave Creek, has scale rows 17, gastrosteges 191, anal divided, urosteges 102, supralabials 8–8, infralabials 10–10, preoculars 1–2, postoculars 2–2, temporals 2+2+2, loreal 1–1, posterior genials longer.

No. 30672, Yuma, Oct. 22, 1911, has scale rows 17, gastrosteges 199, anal divided, urosteges 105, supralabials 8–8, infralabials 10–10, preoculars 1–1, postoculars 2–2, temporals 2+2+2, loreal 1–1, posterior genials longer.

No. 30673, Yuma, Oct. 22, 1911, has scale rows 17, gastrosteges 194, anal divided, urosteges 35+, supralabials 8–8, infralabials 10–10, preoculars 1–1, postoculars 2–2, temporals 2+2+2, loreal 1–1, posterior genials longer.

62.—**Bascanion piceum** Cope

Two specimens were captured in the bed of the Santa Cruz River near Tucson, May 29, 1912, and one was seen near the steam pump eighteen miles north of Tucson, and a fourth specimen was found dead in the central part of Pima county.

The specimens caught May 29, 1912, were apparently mating. They were lying on the sand at full length but entwined. When disturbed they immediately separated and instantly mounted to the top of a willow tree some twenty feet high, where they were captured with much difficulty. Both were jet black with the lower surfaces a beautiful coral pink. The fact that these two black snakes were mating is very interesting, since it would seem to indicate that they may really represent a distinct species rather than a melanistic phase of *Bascanion flagellum frenatum.*

In addition to the above localities these black racers have been taken at Fort Lowell and at Camp Grant, Arizona, and near Ensenada, Lower California.

No. 33871, a female, has scales in 17 rows, gastrosteges 195, and divided, urosteges 102, supralabials 7–8, infralabials 9–10, preoculars 2–2, postoculars 2–2, temporals 2+2+2, loreal 1–1, posterior genials longer.

No. 33872, a male, has scales in 17 rows, gastrosteges 200, anal divided, urosteges 112, supralabials 8–8, infralabials 10–11, preoculars 2–2, postoculars 2–2, temporals 2+2+2, loreal 1–1, genials equal.

63.—**Bascanion semilineatum** Cope

Several specimens of this snake were captured in the Huachuca Mountains. They were found in the oak region near the lower ends of Miller, Ramsey, and Carr Canyons, July 10–30, 1912. One was found under a stone, one on a wall of rock, and the others on fairly open ground. The lower surfaces were straw-yellow. All have scales in seventeen rows, anal divided, loreal 1–1, postoculars 2–2, supralabials 8–8. The other counts are in order for Nos. 34749, 34750, 34751, 34752; gastrosteges 200, 200, 196, 200, urosteges 129, 138, —, 132, infralabials 9–9, 9–9, 9–10, 10–10, preoculars 1–1, 1–1, 1–1, 2-2, temporals 2+2, 1+2+3, 2+2+3, 2+2+2—2+3+3.

Mr. Herbert Brown showed us a specimen collected at Harshaw, Patagonia Mts., Santa Cruz County, July 20, 1910.

64.—**Bascanion taeniatum** (Hallowell)

One typical specimen of this racer was collected at Oak Creek, Coconino Gounty, September 2, 1912. It was found in the brush on the side of the canyon. It is No. 35235, and has scales in 15 rows, gastrosteges 198, anal divided, urosteges 125, supralabials 8–8 infralabials 9–9, preoculars 2–2, postoculars 2–2, temporals 2+2+2, loreal 1–1, posterior genials longer.

65.—**Arizona elegans** Kennicott

The only snake of this kind obtained, No. 33452, was dug out of a hole in a sand hill east of Yuma, March 19, 1912. It has scales in 27 rows, gastrosteges 209, anal entire, urosteges 49, supralabials 9–8, infralabials 13–12, preoculars 1–1, postoculars 2–2, temporals 2+3, posterior genials divided.

In life the lower surfaces and two to three rows of lateral

along mid back are lighter yellowish with whitish edges and with reddish or reddish brown marking near the base of each scale. The dark markings are in part blackish brown, in part deep olive. The head is light olive with darker olive markings.

This specimen contained a *Dipsosaurus* which it had eaten.

66.—**Pituophis catenifer deserticola** Stejneger

A large specimen, No. 33447, was found under some boards near Yuma, March 17, 1912. Two, Nos. 33869, 33870, were caught near the Santa Crúz River at Tucson, April 9, 1912; one, No. 34755, in Carr Canyon, Huachuca Mts., July 20, 1912, and three specimens, Nos. 17541, 17546, 17547, were secured at Cave Creek.

No. 33447, from Yuma, has scale rows 33, gastrosteges 258, anal single, urosteges 59, supralabials 8–8, infralabials 12–12, preoculars 1–1, postoculars 4–5, temporals 3+3 loreal 1–1, posterior genials shorter. This snake contained a small rodent.

No. 33869, from Tucson, has scale rows 33, gastrosteges 237, anal single, urosteges 59, supralabials 9–10, infralabials 12–12, preoculars 1–1, postoculars 3–4, temporals 2+3, loreal 1–1, posterior genials shorter.

No. 33870, from Tucson, has scale rows 31, gastrosteges 226, anal single, urosteges 64, supralabials 8–8, infralabials 13–13, preoculars 1–1, postoculars 3–3, temporals 3+3, loreal 1–1, posterior genials shorter.

No. 34755, from Huachuca Mts., has scale rows 33, gastrosteges 233, anal divided, urosteges 57, supralabials 8–8, infralabials 13–14, preoculars 1–1, postoculars 3–4, temporals 4+4, loreal 1–1, posterior genials shorter.

No. 17541, from Cave Creek, has scale rows 31, gastrosteges 237, anal single, urosteges 64, supralabials 9–9, infralabials 14–14, preoculars 2–2, postoculars 4–4, temporals 3–3, loreal 1–1, posterior genials shorter.

No. 17546, from Cave Creek, has scale rows 35, gastrosteges 245, anal single, urosteges 60, supralabials 9–9, preoculars 1–1, postoculars 3–3, loreal 1–1, posterior genials shorter.

No. 17547, from Cave Creek, has scale rows 31, gastrosteges 235, anal single, urosteges 57, supralabials 8–8, infralabials 12–12, preoculars 1–1, postoculars 3–3, temporals 4+4, loreal 1–1, posterior genials shorter.

67.—**Thamnophis vagrans** (Baird and Girard)

Our collection includes only one Arizonan specimen of this snake. It (No. 35266) was caught Sept. 1–3, 1912, on Oak Creek, Coconino County, with numerous specimens of *Thamnophis eques* and *T. angustirostris.* All three species were found in the water or on the rocks in the stream.

No. 35266 has 21–19–17 scale rows, gastrosteges 148, anal entire, urosteges 76, supralabials 8–8, infralabials 10–10, preoculars 1–1, postoculars 3–3, loreals 1–1, temporals 1+2, posterior genials slightly shorter. The dorsal line is rather indistinct except anteriorly, but it can be seen that the upper spots encroach upon it. The lateral lines are upon the second and third rows of scales. There are no definite dark nuchal blotches or light postoral crescents. The gastrosteges show only a little dark brown or black along their anterior edges.

This species has been recorded from Fort Verde, Fort Whipple, San Francisco Mountain, Mineral Spring and Prescott, Arizona.

68.—**Thamnophis eques** (Reuss)

We have at hand twenty-one specimens of this snake. Three (Nos. 17543, 17544, and 17545) are from Cave Creek, Maricopa County, May 9, 1910. Ten (Nos. 35256 to 35265) were secured at Oak Creek, Coconino County, Sept. 1–3, 1912. Two (34169 and 34170) were shot in Sabino Canyon, Santa Catalina Mountains, April 4, 1912. The other six (34277 to 34282) were collected in the foothills of the Catalina Mountains near the steam pump eighteen miles north of Tucson, May 10–18, 1912.

All of these specimens show the normal coloration with lateral lines on the second and third rows of scales, prominent dark nuchal blotches and no light postoral crescents. Variation in scale characters is given in the following table:

No.	Scale rows	Gastrosteges	Urosteges	Supralabials	Infralabials	Preoculars	Postoculars	Loreal	Temporals
17543	19—17	164	82	8—8	10—10	1—1	3—3	1—1	1+2
17544	19—17	172	47+	8—8	10—10	1—1	3—3	1—1	1+2
17545	19—17	172	93	8—9	11—11	1—1	3—3	1—1	1+3
34169	19—17	167	77	8—8	10—10	1—1	3—4	1—1	1+2
34170	19—17	167	85	8—8	10—10	1—2	3—3	1—1	1+3
34277	19—17	167	97	8—8	10—10	1—1	3—3	1—1	1+2—1+3
34278	19—17	174	93	8—8	10—10	1—1	3—3	1—1	1+2
34279	19—17	171	80	8—8	10—10	1—1	3—3	1—1	2+3
34280	19—17	173	87	8—8	10—10	1—1	3—3	1—1	1+2
34281	19—17	166	55+	8—9	10—10	1—1	3—3	1—1	1+3
34282	19—17	166	48+	8—8	10—10	1—1	3—3	1—1	1+2
35256	19—17		92	8—8	10—10	1—1	3—3	1—1	1+2—1+3
35257	19—17	170	90	8—8	10—10	1—1	3—3	1—1	1+2
35258	21—19—17	166	88	8—8	10—10	1—1	3—3	1—1	1+2
35259	19—17	173	96	8—8	10—10	1—1	2—2	1—1	1+2
35260	19—17	175	92	8—8	9—10	1—1	3—4	1—1	1+2
35261	19—17	168	88	8—8	10—11	1—1	3—3	1—1	1+2
35262	19—17	170	88	8—8	10—10	1—1	3—4	1—1	1+2
35263	19—17	172	97	8—8	10—10	1—1	3—3	1—1	1+2
35264	19—17	171	91	8—8	10—10	1—1	3—3	1—1	1+2
35265	19—17	170	86	8—8	11—11	1—1	3—3	1—1	1+2—1+3

69.—**Thamnophis marcianus** (Baird and Girard)

Four specimens of this species are in the collection. Nos. 35298, 35299, and 35300 are from Tucson Aug. 22–23, 1912, while No. 35159 was caught at Fairbank, Cochise County, August 16–17, 1912. These specimens agree in coloration, having postoral crests, dark nuchal blotches, lateral line on third row of scales or indefinite, large dorsal spots, and gastrosteges marked with black laterally.

No. 35298, has scale rows 21–19–17, gastrosteges 149, anal entire, urosteges 64, supralabials 8–8, infralabials 10–10, preoculars 1–1, postoculars 3–4, loreal 1–1, temporal 1+3–2+3, posterior genials longer.

No. 35299, has scale rows 21–19–17, gastrosteges 162, anal entire, urosteges 65, supralabials 8–8, infralabials 10–11, preoculars 1–1, postoculars 3–4, loreal 1–1, temporals 1+2+3, posterior genials longer.

No. 35300, has scale rows 21–19–17, gastrosteges 156, anal entire, urosteges 65, supralabials 8–8, infralabials 10–11, preoculars 1–1, postoculars 4–4, loreal 1–1, temporals 1+3+3–1+3+3, posterior genials longer.

No. 35159, has scale rows 21–19–17, gastrosteges 157, anal entire, urosteges 67, supralabials 8–8, infralabials 10–11, preoculars 1–1, postoculars 3–3, loreal 1–1, temporals 1+3, posterior genials longer.

These snakes were caught in mud puddles on the desert a mile or more from the river.

Mr. Herbert Brown sent us a number from Yuma, but they were destroyed in the San Francisco fire of April, 1906.

70.—**Thamnophis megalops** (Kennicott)

We have six specimens of this garter snake. Nos. 35158, 35160, 35161, were collected at Fairbank, Cochise County, August 15–17, 1912. Nos. 33876, 33877, and 33878, were caught at Tucson, March 20–April 13, 1912. These specimens all have loreals 1–1, preoculars 1–1, anal entire, posterior genials longer. No distinct postoral light crescents, no very definite dark blotches on nape, lateral lines on the third and fourth rows of scales. Variation is shown in the following table:

No.	Scale rows	Gastrosteges	Urosteges	Supralabials	Infralabials	Postoculars	Temporals
33876	21—19—17	162	75	8—8	10—10	3—4	1+3
33877	21—19—17	154	38+	8—9	10—10	3—4	1+2—1+3
33878	21—19—17	157	74	8—8	10—10	3—3	1+3
35158	21—23—21—19	159	77	8—8	10—10	3—4	1+2+3
35160	21—19—17	161		8—8	10—10	3—3	1+2+3
35161	21—19—17	162	72	8—9	10—10	4—4	1+2+3

The specimens secured at Tucson were caught close to the Santa Cruz River. No. 33876 was caught at about 4 p. m. in a pool near a ditch. It was swimming several inches below the surface of the water, seemingly in pursuit of the little fish which were very numerous in the pool. The snake soon coiled up under some brush at the edge of the pool, and there we captured it. On the morning of March 30, 1912, we were walking along the banks of the Santa Cruz River hunting frogs, when we heard a cry similar to that of a young kitten.

As we drew nearer indistinct though loud croaking sounds could be heard at intervals interspersed with the kitten-like cries. Soon we discovered a garter snake (No. 33877) of this species coiled up on shore a couple of feet from the edge of the water holding in its jaws a *Rana pipiens,* which it had seized by one hind leg, and which was crying lustily. When we approached still closer, the snake dropped the frog and both made for the water, which the frog succeeded in reaching.

No. 33876, was colored in life as follows: The head above is clear olive. The supralabials are straw yellow, the anterior and posterior ones tinged with olive, and all showing posterior edgings of black. The oculars are yellowish olive. The dorsal line is bright ochre anteriorly, becoming dull yellow on the posterior half of the body. The laterals lines are olive yellow on the neck, but posteriorly become grayish yellow and then cream or grayish white. Nuchal blotches are blackish, but are not very evident. The area between the dorsal and lateral lines is clear olive brown, with two rows of nearly concealed blackish blotches separated by concealed light greenish white areas on the skin between the scales. The lower laterals and tips of the gastrosteges are olive brown, a little lighter than the area between the stripes. The lower surfaces are yellowish white on head and neck, grayish or olive white elsewhere, the gastrosteges with concealed black markings laterally.

71.—**Thamnophis angustirostris** (Kennicott)

Eighteen of these snakes were collected at Oak Creek, Coconino County, Sept. 1–4, 1912. Oak Creek is a mountain stream running through a deep canyon with many oak trees. Perhaps a thousand feet above the stream is the pine forest of the plateau. These snakes were found in the stream, either on rocks or in the water.

All have 21–19–17 scale rows. The posterior genials are either equal to or longer than the anterior.

No. 35248 has the anal divided. The loreals are 1–1 except in No. 35249, which has two on one side of the head. Variation in other scale characters is shown in the following table:

No.	Gastrosteges	Urosteges	Supralabials	Infralabials	Preoculars	Postoculars	Temporals
35238	175	85	8—8	10—10	2—2	3—3	1+1+2—1+1+3
35239	165	69	8—8	9—9	2—2	3—3	1+1+1—1+1+3
35240	170	82	8—7	9—10	2—2	3—3	1+2+3—1+1+3
35241	170	84	8—9	9—10	2—2	3—3	1+2+2—1+1+2
35242	166	72	8—8	10—10	2—2	3—3	1+1+2—1+1+2
35243	165	75	8—8	10—10	2—2	3—4	1+1+3—1+1+3
35244	177	87	8—8	9—10	2—2	3—3	1+1+3—1+2+3
35245	171	85	8—8	10—X	3—2	3—4	1+1+3—1+2+3
35246	166	73	8—9	9—10	2—2	3—4	1+1+2—1+2+2
35247	172	80	8—8	10—10	2—2	3—4	1+1+3—1+1+3
35248	161	72	8—8	10—10	2—2	3—4	1+1+3—1+1+2
35249	172	83	8—8	10—10	2—2	3—4	2+2+3—1+2+3
35250	173	86	8—8	10—10	2—2	3—3	1+1+2—1+1+3
35251	176	87	8—7	9—9	2—2	3—3	1+1+3—1+2+3
35252	167	80	8—8	10—10	2—2	3—4	1+1+3—1+2+3
35253.	165	83	8—8	10—10	2—3	3—4	1+2+3—1+1+3
35254	166	86	7—7	9—9	2—2	3—3	1+1+3—1+1+3
35255	161	74	8—8	9—9	2—2	3—3	1+1+3—1+1+4

72.—**Trimorphodon lyrophanes** Cope

One specimen was obtained from Professor Brown. It is labeled Rosemont, Pima County. It is No. 33846, and has scales in 21 rows, gastrosteges 234, anal divided, urosteges 56+, supralabials 7–7, infralabials 10–11, preoculars 2–2, postoculars 3–3, temporals 2+3–3+4, loreal 2–2, posterior genials shorter. There are thirty-seven dark dorsal blotches, of which nine are on the tail.

73.—**Tantilla nigriceps** Kennicott

A species of *Tantilla* was found to be fairly common along the Santa Cruz River near Tucson, where eleven specimens were collected between March 26 and April 1. One (No. 34171) was secured in Ventana Canyon, near the base of the Catalina Mts., April 28, 1912. They are much smaller than *Tantilla wilcoxi,* and have fewer gastrosteges and no posterior dark border on collar. These twelve specimens agree in having scales in 15 rows, preoculars 1–1, temporals 1–1, supralabials 7–7, infralabials 7–7, anal divided, posterior genials shorter. Other scale counts are:

Number.	Gastrosteges.	Urosteges	Postoculars.
33879	135	58	2-2
33880	140	58	2-2
33881	141	26+	2-2
33882	142	51	2-2
33883	135	64	2-2
33884	143	58	1-1
33885	140	62	2-2
33886	141	64	2-2
33887	148	51	2-2
33888	143	62	2-2
33889	142	59	2-2
34171	135	53	2-2

The first infralabials of all these specimens are separated by the mental.

The collar in all is from one to three rows of scales behind the parietals, is from one to one and a half rows of scales in width, and is not edged with darker scales. The lower surfaces are suffused with coral-red.

Although the type of *T. wilcoxi* was recorded by Cope as *T. nigriceps,* it is probable that the latter has not hitherto been taken in Arizona.

This Arizonan *Tantilla* is readily distinguished from the Californian *Tantilla eiseni* by its smaller number of gastrosteges (135 to 148 as against 167 to 181 in *T. eiseni*). *Tantilla planiceps* from Lower California has only 138 to 140 gastrosteges, but the white nuchal collar is on the sixth and seventh rows of scales behind the parietals. *Tantilla wilcoxi* has a larger number of gastrosteges (148 to 157) and the white collar crosses the parietals.

No. 33885 was colored in life as follows: Upper surface of head dark olive, becoming blackish brown posteriorly. Labials, lower surface of head and neck to sixth gastrostege, tips of all gastrosteges, and two or three rows of lateral scales on each side, grayish white. Upper surfaces (except of head) unicolor, light yellowish hair-brown or brownish straw. Rest of lower surfaces from sixth gastrostege to tip of tail bright coral red.

74.—**Tantilla wilcoxi** Stejneger

The only example of this species secured is a fine large specimen removed from the stomach of a *Diadophis regalis*

caught in Ramsey Canyon, Huachuca Mts., July 29, 1912. It is No. 34757, and has scales in 15 rows, gastrosteges 157, anal divided, urosteges 58, superlabials 7–7, infralabials 7–6, preoculars 1–1, postoculars 2–2, temporals 1+1, posterior genials shorter. The white collar crosses the posterior portion of the parietals and about two rows of scales on the neck. It is about as wide as the length of three scales, and is bordered behind by a dark band about the width of one scale row, and is similarly edged with dark anteriorly. The first infralabials just meet on the midline. The color below is coral-red.

This species may be distinguished from *T. nigriceps* by the position of the light collar, the larger number of gastrosteges, and the meeting of the first infralabials.

The specimen collected in the Huachucas by Mr. Price, August 20, 1893, originally recorded by me (Proc. Cal. Acad. Sci. (2), VI, 1896, p. 346), as *T. coronata* has only 148 gastrosteges, while Dr. Stejneger's type has 152.

75.—**Elaps euryxanthus** Kennicott

Nos. 35324 and 33837 from Tucson, and No. 33845 from Rosemont, Pima County, were presented by Professor Brown, while No. 35326 was secured from the Carnegie Desert Laboratory at Tucson.

No. 33837, from the University Campus, Tucson, May 31, 1905, has scales in 15 rows, supralabials 7–7, infralabials 7–7, preoculars 1–1, postoculars 2–2, temporals 1+2, black bands on body and tail 14.

No. 35324, Tucson, has scale rows 15, gastrosteges 216, anal divided, urosteges 29, supralabials 7–7, infralabials 6–6, preoculars 1–1, postoculars 2–2, temporals 1+2, black bands on body and tail 12, yellow 22, red 10.

No. 33845, Rosemont, Sept. 22, 1902, has scale rows 17, gastrosteges 224, anal divided, urosteges 24, supralabials 7, infralabials 8, preocular 1, postoculars 2, temporals 1–2, black bands on body and tail 13, yellow 24, red 11.

No. 35326, Tucson, has scale rows 15, anal divided, urosteges 25, black bands on body and tail 9, yellow 19, red 9.

77.—**Crotalus molossus** Baird and Girard

Seven specimens of this rattlesnake are in the collection. One (No. 17535) was collected, April 4, 1910, at Cave Creek, Maricopa County. The others are from the Huachuca Mts., in Cochise County.

No. 17535, Cave Creek, has scale rows 27, gastrosteges 191, anal entire, urosteges 25, two divided, supralabials 17–18, infralabials 17–18, preoculars 2–2, postoculars 3–3, loreal 2–3,

No. 34735, near Ramsey Canyon, Huachuca Mts., June 29, 1912, female, has scale rows 27, gastrosteges 189, anal entire, urosteges 22, supralabials 17–18, infralabials 16–16, preoculars 2–2, postoculars 3–3, loreal 1–1.

No. 34736, head of Ramsey Canyon, July 11, 1912, has scale rows 27, gastrosteges 190, anal entire, urosteges 23 two divided, supralabials 17–17, infralabials 15–16, preoculars 2–2, postoculars 3–3, loreal 1–1.

No. 34737, Ramsey Canyon, July 30, 1912, has scale rows 27, gastrosteges 193, anal entire, urosteges 21, supralabials 17–17, infralabials 18–18, preoculars 2–2, postoculars 3–3, loreal 1–1.

No. 34738, Ramsey Canyon, July, 1912, has scale rows 27, gastrosteges 191, anal entire, urosteges 27, supralabials 16–17, infralabials 17–18, preocular 2–2, postoculars 3, loreal 1–1.

No. 34739, Miller Canyon, Huachuca Mts., July 27, 1912, female containing seven young, has scale rows 27, gastrosteges 191, anal entire, urosteges 23, supralabials 17–18, infralabials 16–18, preoculars 2–2, postoculars 3–3, loreal 1–1.

No. 34740, Ramsey Canyon, July 28, 1912, has scale rows 27, gastroteges 194, anal entire, urosteges 20 two divided, supralabials 18–18, infralabials 17–18, preoculars 2–2, postoculars 3–3, loreal 1–1.

78.—**Crotalus atrox** Baird and Girard

The collection includes one specimen (No. 33656) from Yuma, Sept. 14, 1912, six (Nos. 17532, 17533, 17534, 17536, 17537, 17538) from Cave Creek, Maricopa County, April 10–May 15, 1910, and ten from the vicinity of Tucson, April 11–August 23, 1912. These all show the typical coloration. Their scale characters are shown in the following table:

No.	Scale rows	Gastrosteges	Urosteges	Supralabials	Infralabials	Preoculars	Postoculars	Loreal
33656		183	24 (1+)	15—16	17—17	2—2	3—3	1—1
17532	27	188	22 (1+)	15—15	16—16	2—2	3—3	1—1
17533	27	186	18 (4+)	15—15	16—17	2—2	3—3	1—1
17534	25	184	23 (0+)	14—14	16—16	2—2	3—3	1—1
17536	27	185	18 (2+)	15—17	18—19	2—2	3—3	1—1
17537	25	185	21 (5+)	16—16	16—16	2—2	3—3	1—1
17538	27	182	24 (10+)	14—15	16—17	2—2	3—3	1—1
33873	25	179	24 (3+)	15—15	15—15	2—2	3—3	1—1
34265	27	183	23 (1+)	15—16	17—17	2—2	3—3	1—1
34266	25	187	19 (3+)	15—15	17—18	2—2	3—3	1—1
34267	25	183	26 (5+)	16—16	18—18	2—2	3—3	1—1
34268	25	183	24 (1+)	14—14	16—17	2—2	3—3	1—1
34269	25	181	27 (0+)	14—14	14—15	2—2	3—3	1—1
34270	27	190	21 (1+)	15—17	16—16	2—2	3—3	1—1
34271	25	184	25 (4+)	15—14	17—17	2—2	3—3	1—1
34273	25	185	19 (2+)	15—15	16—18	2—2	3—3	1—1
35297	25	183	24 (0+)	15—16	18—18	2—2	3—3	0—0

79.—**Crotalus tigris** Kennicott

This species seems to be quite rare in southern Arizona. We secured only one specimen (No. 34274) near the steam pump about eighteen miles north of Tucson, May 8, 1912. This one was caught about four p. m. just as it was entering a hole in the ground. *Crotalus atrox* was common in the same locality.

The scale rows are 25, gastrosteges 165, anal entire, urosteges 20, supralabials 14–14, infralabials 14–15, preoculars 2–2, postoculars 2–3, loreals 1–1. There are forty dark bars on the body and five on the tail.

80.—**Crotalus confluentus** Say

We refer to this species one specimen (No. 17531) from Cave Creek, Maricopa County. The coloration in life was greenish. In alcohol it is pale and resembles *C. atrox*. The bands on the tail are pure black on a light ground as in *C. atrox*. On the posterior portion of the body the rhombs become cross-bars. The lower surfaces are white, unmarked. The head markings are somewhat faded, but in position and character are those of *C. confluentus,* with which species it agrees in scale characters.

It has scales in 25 rows, gastrosteges 177, anal entire, urosteges 19, two divided, supralabials 16–16, infralabials 16–

16, preocular 2–2, postoculars 3–3, loreal 1–1, dark markings on body are 26 rhombs and 12 cross-bars to anus, 4 black bands on tail.

81.—**Crotalus oregonus** Holbrook

We have three Arizonan specimens of the Pacific Rattlesnake. One is a young specimen (No. 35237) from Oak Creek, Coconino County, Sept. 2, 1912. The coloration of head, body, and tail is perfectly typical of this species. The scales are in 23 rows, gastrosteges 165, anal entire, urosteges 24, supralabials 15–15, infralabials 15–15, preoculars 2–2, postoculars 3–3, loreals 1–1, dark dorsal markings on body 38.

No. 17539, is a large adult secured at Cave Creek, Maricopa County, May 1, 1910. Its head is unicolor above and on sides, dark brown without any trace of markings. The dorsal rhombs are somewhat indistinct, and number 33 on the body to the tail, which bears six brown cross-bars. The lower surfaces are mottled with brown. The scale rows are 25, gastrosteges 170, anal entire, urosteges 24, supralabials 15–15, infralabials 14–15, preoculars 2–2, postoculars 3–3, loreal 1–1.

No. 34683, caught at an altitude between 7000 and 8000 feet at the Wilderness of Rocks, on Mt. Lemon, Santa Catalina mountains, Pima County, June 12, 1912, has dorsal rhombs solid jet-black without lighter centers, but separated from each other by bright sulphur yellow edgings. The sides are brownish drab with dark brown markings and a few scattered yellow scales. The lower surfaces are yellowish white marbled with dark brown. There are eight dark brown rings on the tail, separated by narrow dark gray intervals. The head markings are as in typical *C. oregonus*. Scale rows 25, gastrosteges 170, anal entire, urosteges 25 one divided, supralabials 16–16, infralabials 15–15, preoculars 2–2, postoculars 3–3, loreals 1–1, dorsal rhombs to tail 31.

When we reached Tucson we heard much of the black rattlesnake of the Catalinas, as this species is locally known. It was with much difficulty that we secured a specimen (No. 34683). There can be no doubt that it is specifically identical with *C. oregonus* of California. Whether it will be necessary to regard the dark Arizona snakes as a subspecies, *C. oregonus cerberus* (Coues), cannot be decided until more specimens are

received. The lighter specimens from Cave and Oak creeks make us doubt the wisdom of using a distinct name for these snakes. *Crotalus oregonus* probably occurs in Arizona only at considerable altitudes.

82.—**Crotalus cerastes** Hallowell

This rattlesnake was found by us near Yuma, where five were secured.

No. 33450, March 15, 1912, adult, found coiled in the mouth of a hole under a cactus.—Scale rows 21, gastrosteges 145, anal entire, urosteges 21, none divided, supralabials 12–12, infralabials 13–13, preoculars 2–2, postoculars 3–3 loreals 1–1.

No. 33448, March 17, 1912, young, found crawling under a bush.—Scale rows 23, gastrosteges 139, anal entire, urosteges 21, five divided, supralabials 12–12, infralabials 12–12, preoculars 2–2, postoculars 3–3, loreals 1–1.

No. 33449, March 17, 1912, young, found coiled in the mouth of a hole.—Scale rows 23, gastrosteges 143, anal entire, urosteges 23, one divided, supralabials 13–13, infralabials 13–13, preoculars 2–2, postoculars 3–3, loreals 1–1.

No. 33654, Sept. 16, 1912, adult, caught on the desert at night.—Scale rows 21, gastrosteges 146, anal entire, urosteges 15, one divided, supralabials 12–12, infralabials 13–13, loreals 1–1.

No. 33655, Sept. 12, 1912, young, found under a tin can on desert.—Scale rows 21, gastrosteges 146, anal entire, urosteges 16, two divided, supralabials 13–13, infralabials 13–13, preoculars 2–2, postoculars 3–3, loreals 1–1.

No. 33448 contained a *Uta stansburiana,* while No. 33449 had eaten a *Cnemidophorus tigris.*

83.—**Crotalus mitchellii** Cope

Two bright red specimens of this species were secured by Mr. Carlson at Cave Creek, Maricopa County: No. 17540 on April 16, and No. 20814 on May 25, 1910.

No. 17540 has scale rows 23, gastrosteges 163, anal entire, urosteges 18, none divided, supralabials 15–15, infralabials 14–16, preoculars 2–2, postoculars 3–3.

No. 20814 has scale rows 25, gastrosteges 169, anal entire, urosteges 21, three divided, supralabials 15–17, infralabials

16–17, preocular 2–2, postoculars 3–3.

Mr. Herbert Brown sent us two white rattlesnakes of this species collected by Dr. W. J. McGee in the Tinajas Atlas Range about fifty miles southeast from Yuma. Unfortunately they were destroyed in the great fire of April, 1906.

84.—**Crotalus lepidus** Kennicott

The only specimen secured was found crawling up a granite boulder on the hillside above Carr Canyon, Huachuca Mts., July 17, 1912. In life the coloration was light green, with light brown bands. No. 34747 has scale rows 21, gastrosteges 162, anal entire, urosteges 24, none divided, supralabials 11–12, infralabials 11–12, preoculars 2–2, postoculars 2–2, loreals 2–2.

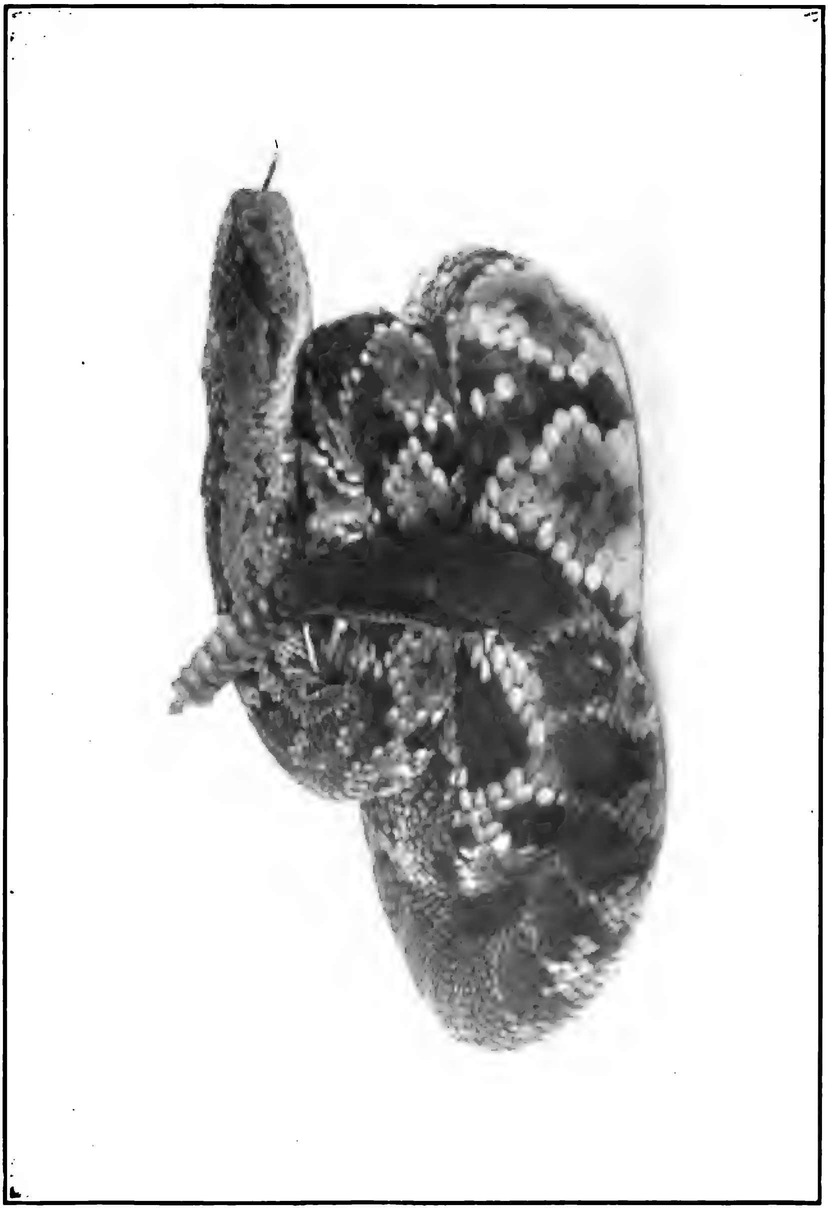
85.—**Crotalus pricei** Van Denburgh

The only specimen of this handsome little rattlesnake was found in the bed of a stream in Ramsey Canyon, Huachuca Mts., July 16, 1912. It is No. 34748, and has scales in 21 rows, gastrosteges 154, anal entire, urosteges 24, nine divided, supralabials 9–9, infralabials 10–10, preoculars 2–2, postoculars 3–3, loreals 2–2, coloration typical.

Mr. Herbert Brown sent me for examination a fine specimen found by Mr. W. B. McCleary, May 28, 1912, on a rock at an altitude of about 7500 feet, on a ridge near Old Baldy, Madero Canyon, Santa Rita Mts., Santa Cruz County. This snake has scales in 23–21–21–21–19–17 rows, gastrosteges 153, anal entire, urosteges 25, the last seven divided, supralabials 9–9, infralabials 10–10, spots along back to anus 48 on right, 56 on left, 8 dark bars on tail. Length to anus 395 mm., of tail 38 mm. to rattle. Rattle 17 mm. complete with seven segments.

EXPLANATION OF PLATE XVII

Crotalus molossus Baird and Girard: BLACK-TAILED RATTLESNAKE—Photograph from alcoholic specimen (No. 34738) collected in Ramsey Canyon, Huachuca Mountains, Arizona, July, 1912.

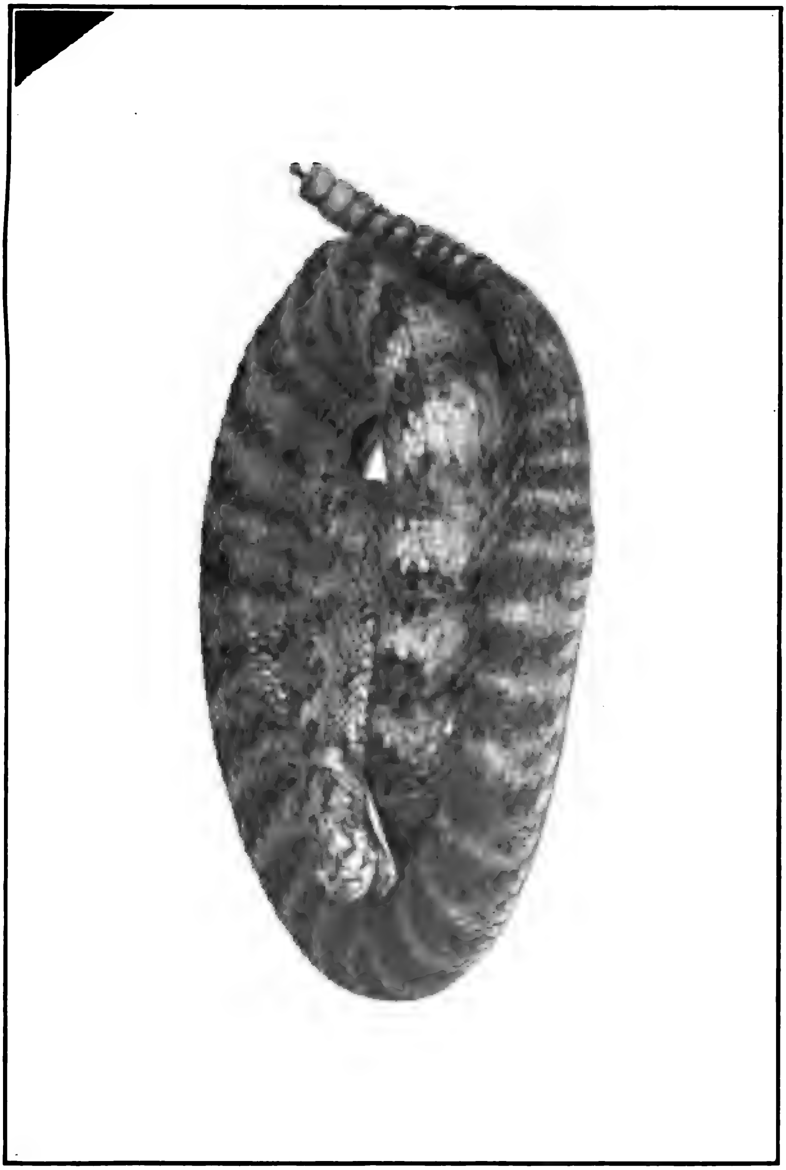


EXPLANATION OF PLATE XVIII

Crotalus atrox Baird and Girard: DESERT DIAMOND RATTLESNAKE—Photograph from living specimen (field No. 1011) collected near Tucson, Arizona, August, 1912.

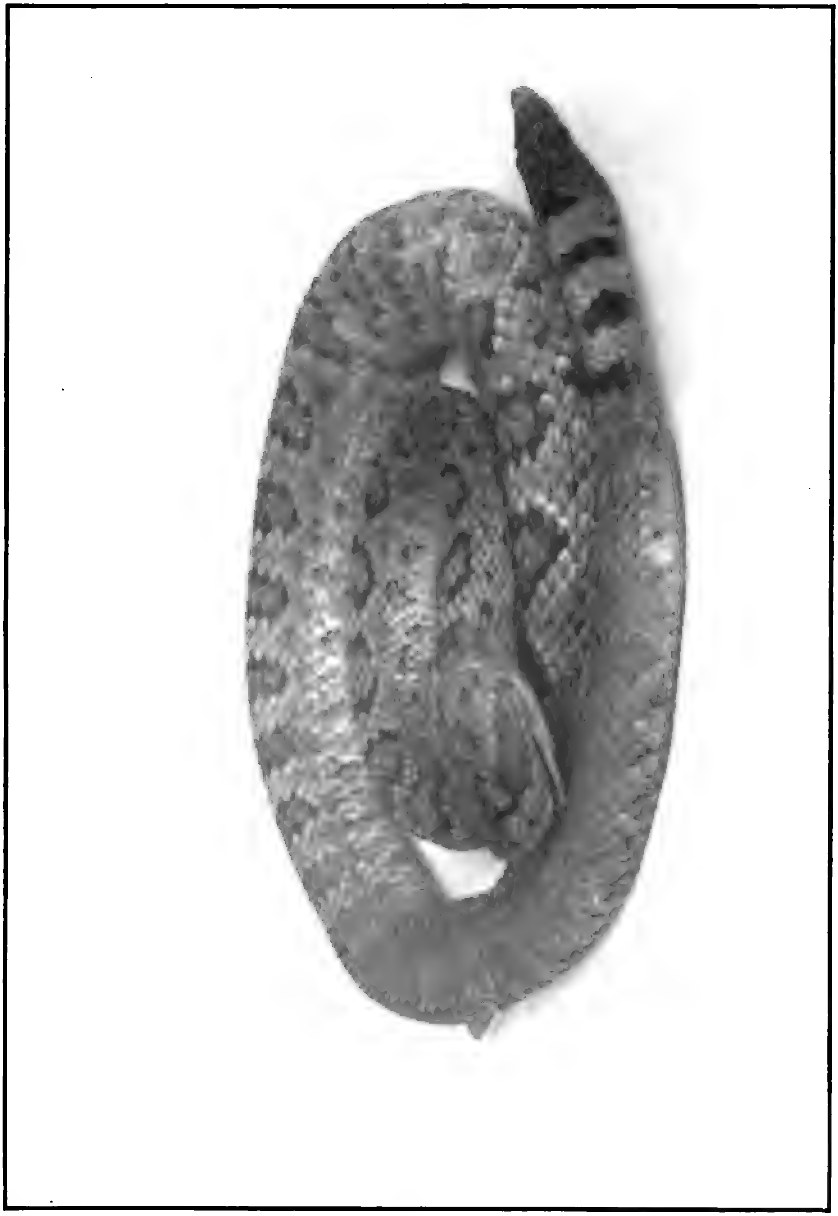
EXPLANATION OF PLATE XIX

Crotalus tigris Kennicott: Tiger Rattlesnake—Photograph from alcoholic specimen (No. 34274) collected near the Steam Pump eighteen miles north of Tucson, Arizona, May 8, 1912.



EXPLANATION OF PLATE XX

Crotalus confluentus Say: PRAIRIE RATTLESNAKE—Photograph from alcoholic specimen (No. 17531) collected at Cave Creek, Maricopa Co., Arizona, in 1910.



EXPLANATION OF PLATE XXI.

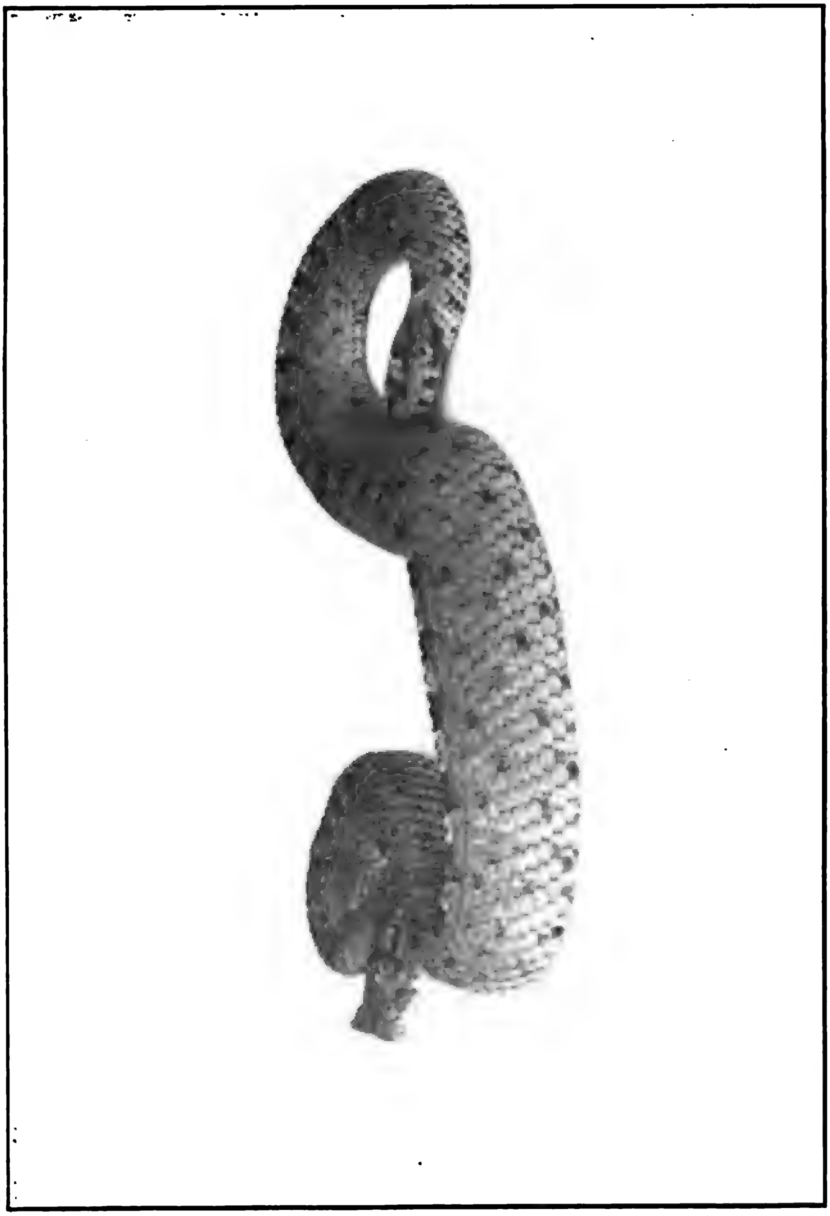
Crotalus oregonus Holbrook: PACIFIC RATTLESNAKE—Photograph from alcoholic specimen (No. 34683) collected on Mt. Lemon, Santa Catalina Mountains, Arizona, June 12, 1912.

November 3, 1913

November 3, 1913

EXPLANATION OF PLATE XXII

Crotalus cerastes Hallowell: HORNED RATTLESNAKE—Photograph from living specimen (No. 33655) collected at Yuma, Arizona, Sept. 12, 1912.



EXPLANATION OF PLATE XXIII

Crotalus lepidus Kennicott: GREEN RATTLESNAKE—Photograph from alcoholic specimen (No. 34747) collected in Carr Canyon, Huachuca Mts., Arizona, July 17, 1912.

EXPLANATION OF PLATE XXIV

Crotalus pricei Van Denburgh: Price's Rattlesnake—Photograph from alcoholic specimen (No. 34748) collected in Ramsey Canyon, Huachuca Mts., Arizona, July 16, 1912.

EXPLANATION OF PLATE XXV

Fig. 1. ***Crotalus molossus*** Baird and Girard—Section of skin.
Fig. 2. ***Crotalus atrox*** Baird and Girard—Section of skin.

Fig. 1

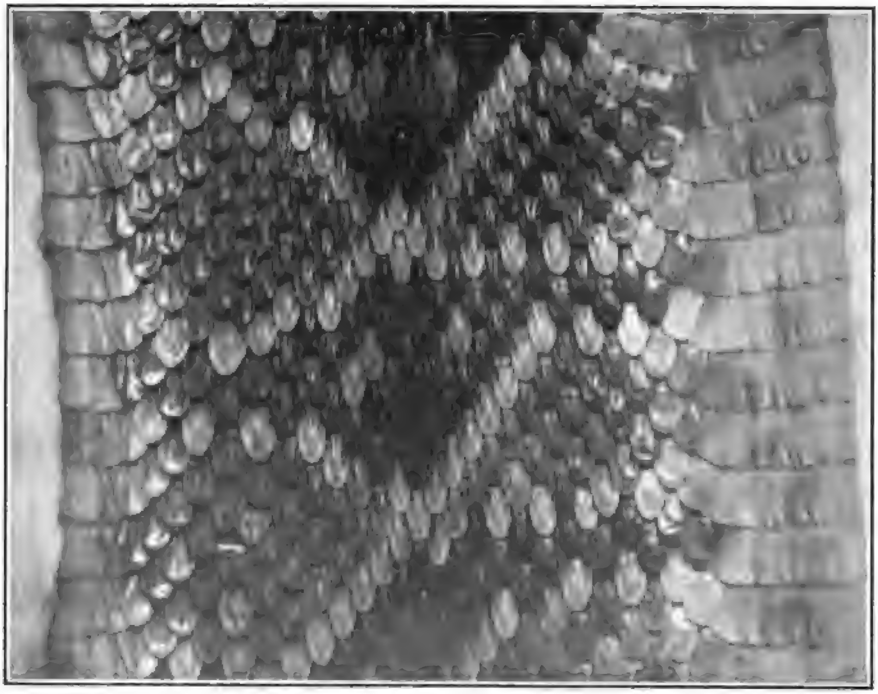
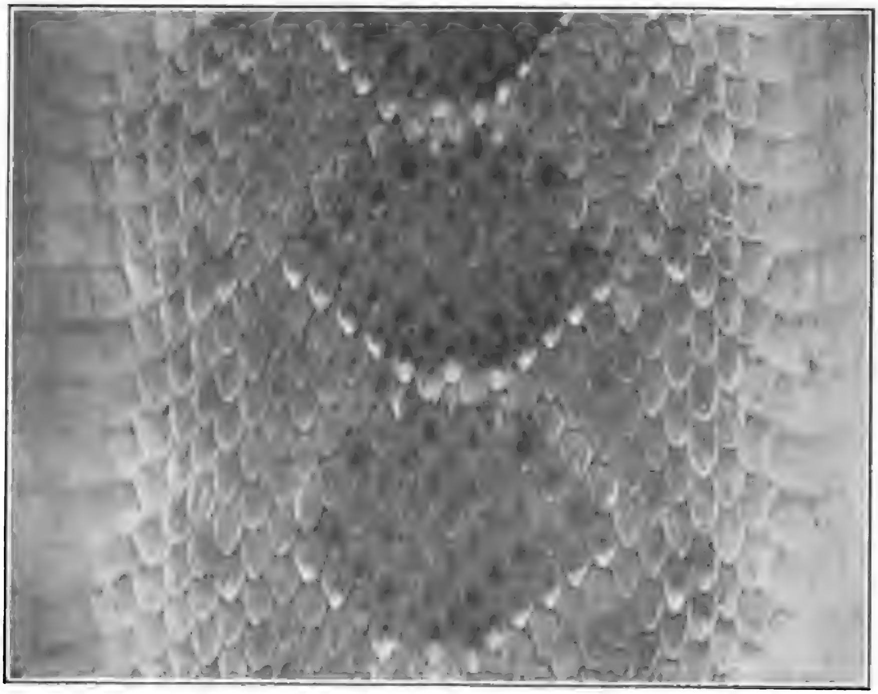


Fig. 2



EXPLANATION OF PLATE XXVI

Fig. 1. *Crotalus tigris* Kennicott—Section of skin.
Fig. 2. *Crotalus mitchellii* Cope—Section of skin.

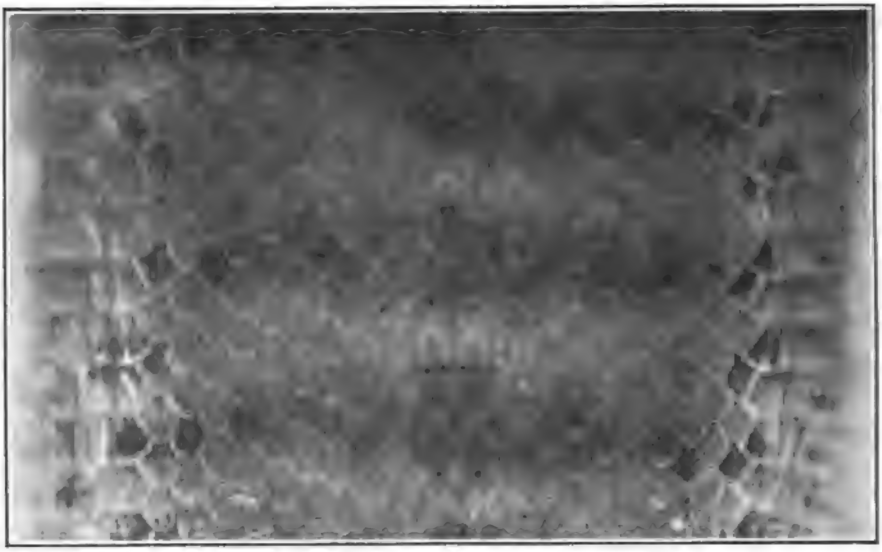


Fig. 1

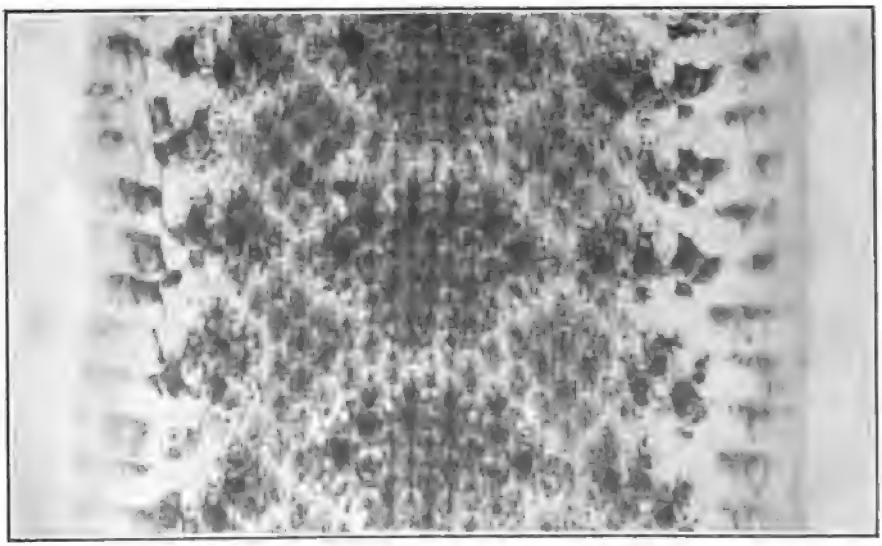


Fig. 2

EXPLANATION OF PLATE XXVII

Fig. 1. *Crotalus confluentus* Say—Section of skin.
Fig. 2. *Crotalus oregonus* Holbrook—Section of skin.

EXPLANATION OF PLATE XXVIII

Fig. 1. *Crotalus cerastes* Hallowell—Section of skin.
Fig. 2. *Crotalus lepidus* Kennicott—Section of skin.
Fig. 3. *Crotalus pricei* Van Denburgh—Section of skin.

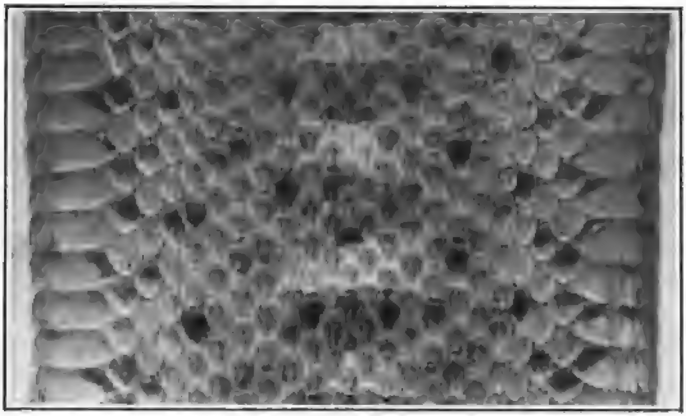


Fig. 1

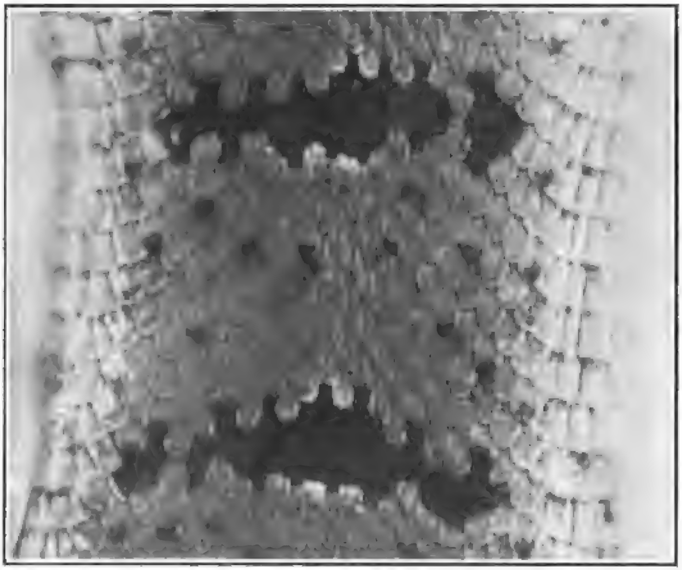


Fig. 2

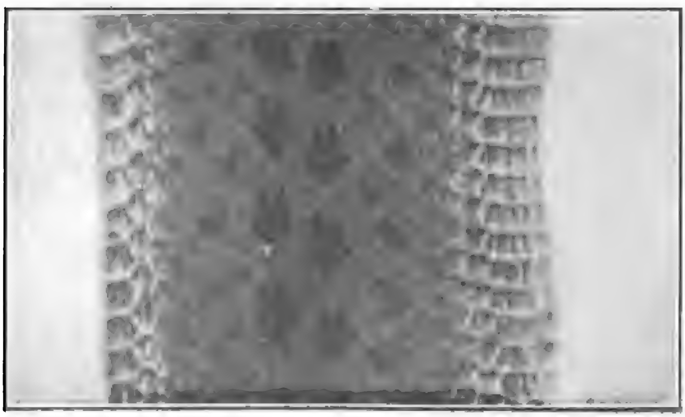


Fig. 3

INDEX TO VOLUME III, FOURTH SERIES.

For Index to A Distributional List of the Mammals of California, see Page 375.

New names in **heavy-faced type**; Synonyms in *italics*.